INFLUENCE OF METACOGNITIVE AWARENESS, GOAL ORIENTATION AND LEARNING STYLES ON PROCESS SKILLS IN CHEMISTRY OF SECONDARY SCHOOL STUDENTS

Thesis
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DECLARATION

I, **Meharunnisa Karadan,** do hereby declare that this thesis, entitled **"INFLUENCE OF METACOGNITIVE AWARENESS, GOAL ORIENTATION AND LEARNING STYLES ON PROCESS SKILLS IN CHEMISTRY OF SECONDARY SCHOOL STUDENTS"** is a genuine record of the research work done by me under the supervision of **Dr. A. Hameed**, Assistant Professor, Department of Education, University of Calicut, and that no part of the thesis has been presented earlier for the award of any other Degree, Diploma, Title or Recognition in any other University.

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Certificate

This is to certify that the thesis entitled "**INFLUENCE OF METACOGNITIVE AWARENESS, GOAL ORIENTATION AND LEARNING STYLES ON PROCESS SKILLS IN CHEMISTRY OF SECONDARY SCHOOL STUDENTS**" is an authentic record of research work carried out by Mrs. Meharunnisa Karadan, for the Degree of Doctor of Philosophy in Education of University of Calicut, under my supervision and guidance and that no part thereof has been presented before for any degree, Diploma or Associateship in any other university.

Calicut University
.01. 2018

Dr. A. Hameed
(Supervising Teacher)

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Meharunnisa Karadan

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Education is a complex system, embedded with physical, psychological and sociological context of teaching - learning which strengthen the inner capacities of children through the acquisition of relevant knowledge, skills and attitudes. One of the major aims of education is bringing quality in different spheres like content, process and environments which ultimately result in the production of diverse outcomes favourable for self as well as for society. Today, the progress index of mankind is reflected by developments and advancements in the field of science and technology. Education provides a proper link between scientific inventions and their dissemination.

Science is a unique subject in its content and process which is essential for cultural integration, equality and equity (UNESCO, 1992). Learning science is an amalgamation of 'learning about science' and 'practising science'. Real reflections of scientific challenges are accomplished by budding blooms in the classrooms. So, science education in schools must be focussed on the production and development of scientifically literate citizens. One of the major goals of science education at secondary level is the creation of young scientists with an inclination for scientific pursuit, capable of questioning and experimenting the world around them (Kerala Curriculum Framework - KCF, 2007).

Process of learning is cumulative, endless and a learner is said to be successful when he/she undergoes reflection, feedback and awareness of his/her own learning process. Secondary level is the corner stone of educational system and is a critical stage in every student's life when their career aspirations begin to sprout and provides gateway to various opportunities. At this period, students are expected to start reasoning abstract concepts and thinking logically, which will allow them deeply engage with what they learn from the class and generate knowledge beyond the text books. Many of the students at secondary level merely memorises concepts in Chemistry, by rote learning and not by conceptual understanding (Haider, 1997; Niaz & Rodriguez, 2000).

The current Science Education Standards (Science for all Americans, 1991; Benchmarks for Scientific Literacy, 1993; National Research Council, 1996) and many national commissions (Kothari Commission 1964-66; National Policy of Education, 1986; and National Curriculum Frameworks, 2000 & 2005) laid stress on the implementation of process approaches and thereby nurturing of process skills among students. Science education must follow effective pedagogic strategies and research findings which help teachers to respond students' motivation, interest and experiences. It should support students in active, guided inquiry and bridge the gap between the world of science and the world of students (Hassard & Dias, 2013). The above reports state that 'inquiry' is a step beyond 'science as a process' which helps to (1) understand and appreciate the nature of science (2) develop skills necessary to become independent inquirers of the world (3) develop dispositions to use the skills, abilities and attitudes associated with science and (4) cultivate skills among learners ranging from simple cognitive process to complex cognitive actions such as problem solving, information processing and skills related to assessing and transferring knowledge in suitable situations (Hassard & Dias, 2013). Hence, different imperatives are to be kept in mind and in use for moulding science education competent for the fast-moving world.

In India, according to the National Curriculum Framework - NCF (2005), for assuring quality science education, there should be a paradigm shift in teaching-learning process in all levels of learning. For assessing the quality, traditional science outcomes must be replaced by new cognitive enterprises like information acquisition skills, intellectual Process Skills and behavioural modifications like scientific appreciation. The basic criteria for good science curricula are represented under six major areas by NCF (2005). In this, 'Process Validity' is the most important of all which suggests that the curricula should engage learner in acquiring the methods and processes, nurture the natural curiosity and creativity of the child in science, lead to the generation and validation of scientific knowledge and finally 'learning to learn' science (NCF, 2005).

KCF (2007) recommended that new science curriculum must be integrated, process-oriented and learner centred by incorporating activity oriented methods, construction of knowledge, learning by making connections with previous knowledge, co-operative learning, issue-based learning and critical approaches. Process Skills are special skills that simplify learning, activate students, develop students' sense of responsibility in their own learning, increase the permanency of learning and teach them the research methods (Karamustafaoglu, 2011). Ohodo (2005) suggested that Chemistry education specifically help learners to develop effective process skills such as observing, classifying, counting, recording, communicating, predicting, hypothesising, inferring, interpreting data, experimenting and making generalisations.

A novice learner avoids rote learning of concepts; instead, uses inquiry based approaches starting from simple cognitive task to complex cognitive problems. Higher order mental processes such as reasoning, problem solving, and reflective thinking emerged from science classes paves ways to develop metacognitive abilities among the learners. The term metacognition is quite difficult as it is thinking beyond thinking, yet all people engage in metacognitive activities and it turn as inseparable part of their everyday life. Studies indicate that metacognition is important in science education because it improves skills like (1) the understanding of science concepts (2) the ability to undergo conceptual change (3) problem solving skill and (4) learning motivation (Hartman, 2001). Costa and Kallick (2001) identified the significant role of metacognition in education because it helps learner to be capable of develop a plan, monitor and evaluate how much it's effective, that means metacognition helps the learner to be more involved in learning process.

Motivation is the key to scientific literacy (Shumow & Schmidt, 2013). Motivating secondary school students to learn science is a primary concern of educators and it is a greater challenge faced by most of the science teachers. In order to enhance adolescents' motivation for learning science, teachers must integrate knowledge about content, instructional methods, and student learning and development (Davis, Petish, & Smithy, 2006). To know the reason behind motivation, researchers observed the behaviour of children and drew inferences that goals adopted by students are the key factor. Goal Orientation is the main purpose that students have motivation for completing an academic task and it has received much attention due to its influential role on students' performance (Ames, 1992; Dweck, 1986). The specific type of goals adopted by individuals determines the personal experience one has following success or failure of the task in which one engages. Studies in the field of Goal orientation engaged researchers in various attempts to determine the types of goals that are most productive for students and what types of goals result in the cognitive strategies, affective responses, and behaviours which lead to student success (Cho, Liu & Schallert, 2008).

In recent years, educators have explored emerging theories about how people learn and studied different types of learning styles used by the students. The research findings on Learning Styles offer substantial promise to teachers, counsellors and the students themselves in terms of finding better ways to learn how to act intelligently when learning seems to be a difficult process. Learning Style theories provide a framework that enable teachers to reap the very best from their learners through developing a variety of instructional methodologies to benefit all learners; recognize the incredibly diverse needs learners bring into the classroom and helping the learners discover how they learn best for optimum academic achievement (Nzesei, 2015).

Once teachers are aware of the unique Learning Styles of students, they will have the capacity to adjust their teaching approaches to best fit to their students' learning preferences. This awareness forces the teachers to have a self-reflection on the current teaching methodologies they use and leads to a refinement. The understanding of Learning Styles of children helps the parent assist and reinforce their children to acquire skills needed for successful schooling (Sabatova, 2008). Thus, the classrooms are transformed into a space for motivated inquiry with individual prominence where meaningful learning occurs. The learners plan, monitor and evaluate settings in their own way leading them to the higher cognitive processes that ultimately develop scientific skills. Learners must have opportunities to conceive and get preferable ways of learning so that their talents must be utilized for the welfare of the society. So these factors have to be identified and researched effectively to validate the nation's vision of education (Geta, 2012).

A host of studies have been conducted to identify the factors that contribute to academic achievement. Since academic achievement is often associated with factors such as teachers, parents and school environments; aspects of intellectual and non-intellectual factors may also affect achievement (Erickson, Peters, & Strommer, 2006). Therefore, the selected factors; Achievement Goal Orientation, Learning Styles and Metacognitive Awareness of students may facilitate or hinder learners' academic achievement in science. So, by connecting the goals, cognitive processing and the way they learn, students can construct a general profile for enhancing their process skills in Chemistry.

Need and Significance of the Study

In this tremendously changing world, the quality of science teaching is crucial. So, science education demands a paradigm shift from "listening science" to "doing science". National Curriculum Framework (2000 & 2005) advocates that teaching and learning of science is to be designed by focussed emphasis on processes of science. There is a need for alternative textbooks which include ample activities and experiments that conceptualise the scientific theories and facts. 96th Indian Science Congress suggested that teaching of science needs to be refined substantially and it must help the students develop skills of procuring information and its analytical examination. National Knowledge Commission (2006-09) recommends that all school children should be encouraged to involve in some practical activities that require working with hands. Poisson (2001) studied the teaching objectives of science in India and demands the widespread concern of science educators about the adequateness of understanding the processes of science and this will be reflected in all science education programmes. So, it is one of the major concerns of researchers to inculcate fruitful outputs by bringing appropriate changes in teaching-learning of secondary science curricula. The secondary level science teachers have more demanding role in giving proper guidance to the pupils to open their eyes towards the importance of science and develop a fruitful career.

In India, great efforts were made and several programmes were launched over the last quarter of the century to improve the quality of science education. The National Science Education Standards (NSES), India's Science Academies and other policy-making bodies set different programmes showing great concern about school science education (Alosaimi, 2013). Unfortunately, these efforts are not making significant changes in science outcomes and science classrooms are seen to be unimproved. Science outcomes in terms of achievements in skills are most important, because it broadly represents the quality, and moreover a crucial standard for measuring all variables associated with process of teaching.

Homi Bhabha Centre for Science Education in India stated that it is unfortunate that the majority of the schools across the country teach science in a boring and mechanical style allowing little room for original thinking and investigation. Most of the time, the students spent on searching for correct answer. This is a false interpretation of science teaching. Science is all about doing and learning even through mistakes (HBCSE, 2004). Examination of different studies on science education shows that achievement in science is influenced by (i) personal factors like academic anxiety, attitude, self-regulation (ii) psychological factors like socio-emotional adjustment, mental health, emotional regulation (iii) social factors like parental encouragement, home environment, socio-economic status and (iv) academic factors which include motivation, learning styles, cognitive style, personality characteristics of teachers, teaching style, organized school climate etc. (Kumar & Pillai, 1993; Aruna & Usha, 2005; Rahman, Jumani, Chaudry & Abbasi, 2010; Coutinho, 2007; Bindu & Aruna, 2014). So, it is the right time to search and explore various factors related to academic performance of the learner.

The investigator belongs to the faculty of science and being a science teacher, had experienced that many of the students in the classrooms are not able to excel and perform better in science subjects even though they are psychologically efficient and brilliant. Another reason noticed by the investigator for their poor performance is that many students perceive learning as an academic burden and they do not enjoy classroom activities. Meanwhile, the beneficiaries like parents, society and even many teachers are eager to talk about and implement various activities for improving the grades/ marks gained by children. Ultimately, this situation leaves the responsibility of learning upon the parents and teachers instead of making the students responsible for their learning. The stakeholders of education are not interested in bringing about permanent and long lasting behaviour modifications such as goal directedness, self regulation, creativity, problem solving and self-reflection.

From various theoretical orientations, the investigator experienced that when the students take responsibility of their own learning process with a predetermined goal or objective of learning, they can easily prefer suitable learning strategies for enhancing their understanding. Moreover, the teachers can easily transact the ideas of the prescribed curricula which will help the learners become proficient and acknowledged in the growing field of science. These are the primary reasons that motivated the investigator to execute a study on the outcomes of science and to study the role of certain academic variables on it.

Debates and discussions among the educational researchers in the field of science suggest that a lot of factors affect achievement of students. This creates disequilibria among ongoing researchers and leads to several questions like: "What are the significant variables contributing to achievement?", "How far different factors influence achievement?", "How can we improve the rate of achievement?". Various curricular materials and the present text books in secondary level proved that learning activities direct students to construct knowledge with the help of systematic use of scientific methods. Engagement of students in inquiry process demands training in several scientific skills ranging from observation to higher level of problem solving. So, the investigator decided to measure achievement of secondary school students in terms of achievement in scientific inquiry skills or Process Skills. Studies conducted under the area of science achievement and review of literature helps the investigator summarise the factors influencing Process Skills under following categories.

1. Variables related to learner characteristics such as intelligence, metacognition, cognitive style, learning styles, motivation, interest, attitude, aptitude, creativity, thinking style, intellectual style, aspiration level, goal setting, etc. The above characteristics are also studied with teachers as sample and had influence upon achievement.

2. Variables related to school environment includes classroom environment, peer interaction, instructional method, co-scholastic activities, class size.

3. Variables related to social environment includes characteristics like parental involvement, parenting style, socio-economic status of the family, home environment, attitude of parents.

From the above identified categories, the investigator understood that one of the major problems experienced in the current scenario is that the process of teaching is very mechanical and the pupil involvement in the process of learning is very little or they are not actively involved. The factors related to learner characteristics are very crucial and those are in need of development since they are closer to the process of teaching-learning. Hence, the investigator selected certain academic variables and investigated their influence on Process Skills in science, especially in Chemistry.

Metacognition is a major point of discussion among researchers and of great importance in educational context as it is a strong predictor of academic success (Narang & Saini, 2013; Kruger & Dunning, 1999). Recent studies also points out that in order to develop higher-order thinking skills in learners, they must be aware of their own 'cognition' and its processing. Many studies reported that metacognition is essential and markedly affects the learning process (Akin, Abaci & Cetin, 2007; Hartman, 2001). Learning outcomes such as achievement, acquisition, comprehension, listening abilities, reading development, Mathematics development, etc. are affected by metacognition (Hartman, 2001; Wilson, 1999; Jacobs & Paris, 1987; Schoenfeld, 1992). Metacognition plays a significant role in enhancing scientific skills like problem solving at the elementary and college level (Swanson, 1990). Furthermore, metacognition creates successful learners with self regulated learning abilities which make them active and constructive participants. It also enables the learners control and monitor their own cognition (Pintrich, 2000; Zimmerman, 1994) and encourages reflective thinking, provides responsibility, builds self-confidence to make decisions quickly (Memnun & Akkaya, 2009). Review of related studies also revealed that the works related to Process Skills in science and metacognition is very few. So, the investigator felt the need for an analysis of how metacognition is linked with performance in Chemistry.

Several researchers proposed different categorisation for the concept of metacognition and is represented by different terms like Metacognitive ability (Baker & Brown, 1984), Metacognitive Knowledge (Sheorey & Mokhatri, 2001), Metacognitive Awareness (Carrell, 1989; Mokhtari & Sheorey, 2002) and Metacognitive Strategies (Yuksel & Yuksel, 2012). Recently, researchers proved that metacognition promotes meaningful learning in science through the enhancement of higher cognitive skills (Jayabraba, 2013; Swanson, 1990). Different studies in the field of metacognition motivated the investigator to select Metacognitive Awareness as a variable of the study as it is not widely studied and conceptualised. Also, limited studies shows that performance of students in the subject of

Chemistry is enhanced with the help of metacognitive factors (Rahman, 2011; Saribas & Bayram, 2009). Above all, the investigator could not locate studies which identified the influence of metacognition on Process Skills since there is evidence that metacognition directly influences the process and product of learning (Zimmerman & Shunk, 2001; Zimmerman, Boekarts, Pintrich & Zeidner, 2000). Because of these reasons the investigator has an urge to study how Process Skills are associated with Metacognitive Awareness.

Motivation of adolescents towards learning is a primary concern of educators and it is a big challenge that many teachers face daily in the classroom. For enhancing students' motivation for learning science, teachers must integrate knowledge about science concept, instructional method, motivation and development (Davis, Petish & Smithy, 2006). The inferences of different studies regarding the reason behind motivation are the type of goal adopted by children during achievement situation (Ames, 1992; Dweck & Legget, 1988; Elliot & Dweck, 1988). Achievement Goal Theory confirmed that individuals engage in academic activities to fulfil different goals (Mattern, 2005). Student's shows different orientations for adopting goals and, through the literature analysis, the investigator used the trichotomous classification as Mastery, Performance-Approach and Performance-Avoidance Goal Orientation. Various studies in this field demonstrated that all these orientations have their own significance in educational context and on student's behavioural patterns like improvements in knowledge and skills (Ames, 1992; Elliot & Dweck, 1988; Vandewalle, 1997).

Recent researches show that one's Goal Orientation is not a stable trait but it can vary due to the nature of task and can even be motivated by multiple goals for a single situation (Dweck, & Leggett, 1988). There are number of studies which show substantial linking between Goal Orientation and academic outcomes such as achievement (Liem, Lau & Nie, 2008), cognitive processing (Anderman, Sinatra & Gray, 2012), Grades and self perceptions (Anderman & Wolters, 2006). Furthermore, young scientists who hold mastery are more productive than those hold performance goals (Shumow & Schmidt, 2013). Also the findings of an empirical study on high school science students concluded that mastery goal will be fostered among secondary level students because they can deeply process the information, they will monitor their own learning, reorganize new information and make connections to prior knowledge (Anderman & Young, 1994; Nolen & Haladyna, 1990). By analysing different studies, the investigator concluded that all the positive outcomes mentioned above are essential for learning of science and understanding about students' Goal Orientation will help teachers to design their classroom practices to promote optimal student motivation. Researches also points out that a higher level of Mastery Goal Orientation is related to greater academic achievement in both younger and older students (Broussard & Garrison, 2004). The investigator thinks that when a person is praised or motivated by his/her own activities both physically and intellectually, it is quiet easier to direct them towards the state of potential level from the actual level. Again, the investigator noticed that studies that established the relation between scientific Process Skills and Goal Orientation are limited in number. These factors inspired the investigator to select Goal Orientation as an independent variable and to study the association between Goal Orientation and Process Skills.

Researchers agreed upon a common notion that all human beings have common bio-psychological and social characteristics when they engaged in learning process, individual preferences will be seen in ways of giving meaning and acquiring information (Yilmaz-Soylu & Akkoyunlu, 2009). This directed the investigator to explore, and understand about how people learn and can tailor instruction accordingly. Theories show that when learners are taught about the concept of Learning Styles, they are more empowered to act intelligently when learning seems difficult for them. Identification of Leaning Style is vital and it is helpful for teachers, students, and parents and even for educational administers for creating a conducive learning environment (Dunn, 1984; Felder & Spurlin, 2005). Different studies revealed that Learning Styles is an important indicator of meaningful learning and positively related to the academic performance (Schmid, Yeung & Read, 2009) and guide the way in which they perceive, interact and respond to learning environment (Rasimah & Zurina, 2008; Brown, 2003). These factors validated the need of a study between Learning Styles and Science Process Skills because it is fundamental for formulating basic concepts of Science.

Again, the investigator limited the study to the subject of Chemistry because of her keen interest in this subject and more associated with teaching Chemistry in school level. Above all, concepts of Chemistry are more abstract in nature and cannot be taught through traditional way of teaching involving mere rote learning of facts and concepts. Moreover, subjects such as Physics, Chemistry, Biology, etc. are ever changing and relatively unfamiliar, and somewhat difficult as compared with other subjects. So the learners have to be more active, exploratory and self-regulated during the comprehension-building process (Tergan, 1997). Several efforts are made to diagnose the problems associated with teaching and learning of Chemistry (Berg, 2005; Kolawole, Oginni & Fayomi, 2011; Emendu & Okoye, 2015) and put forward recommendations regarding teaching methods, instructional materials and home and School-related personal and environmental factors that could enhance the achievement in Chemistry. However, the Chemistry education at secondary level is deprived of several factors and its achievement at secondary level is low and unimpressive. Also the researcher noted that; in India, many educationists revised the mode of educational processes including changes in approach of teaching, changes in the role of learners and teachers, method of teaching, assessment procedures etc. Unfortunately, none of these initiatives provide a specific mechanism for teaching-learning process for students; to understand how they learn and control it, for teachers; what the best strategy is and how to implement it. Most of our classroom situations and materials rarely inform students explicitly about goals and why they are using certain strategies or get them to reflect on how they are learning. Also the investigator assumed that, if the classroom environment is adapted to the Learning Styles of each students, developing the metacognitive competences with successful orientations in adopting goals, it will be transfused for better process oriented Science learning. These factors channelized the investigator to study the influence of Metacognition, Goal Orientation and Learning Styles on Basic and Integrated Process Skills in Chemistry of Secondary School Students.

Statement of the Problem

For the last many years the topics of great importance for educational researchers at different educational level was how to improve the academic achievement and how to predict it effectively. One of the major aims of secondary educations is to produce high quality learning outcomes among students. A number of factors could be ascribed to students' academic performance in school. For this, we need to understand the present conditions, problems and reflect upon the solutions.

In secondary school level, effective transaction of the concepts of science is prevailing as a major problem for teachers as well as students. For removing this inadequacy, pupil's active participation has to be needed and this can be easily possible by the development of Science Process Skills. In order to produce strategic learners; sufficient training has to be given in cognitive processing, motivated behaviours and the way in which they learn; so that scientific skills are effectively used and applied in noval situations. Hence the study composed of Metacognitive Awareness, Goal Orientation and Learning Styles as Predictor Variables and Basic and Integrated Process Skills in Chemistry as Criterion Variables. Hence the present study is entitled as **Influence of Metacognitive Awareness, Goal Orientation and Learning Styles on Process Skills in Chemistry of Secondary School Students.**

Definitions of Key Terms

The important key words used in the statement of the problem are defined as follows.

Influence

Influence is the capacity to have an effect on the character, development, or behaviour of someone or something, or the effect itself (Oxford Dictionary of Current English, 2011).

For the present study, Influence is the capacity of Metacognitive Awareness, Goal Orientation and Learning Styles to have an effect on the Basic and Integrated Process Skills in Chemistry of Secondary School Students.

Metacognitive Awareness

Metacognitive Awareness is the individual's beliefs about oneself and about others as learners and of the requirements involved in the learning process related to metacognitive knowledge acquired through both conscious and unconscious means, and in formal and informal settings (Flavell, 1979).

For the present study, Metacognitive Awareness is defined as learners' awareness/self assessment about how they (1) prepare and plan for learning, (2) select and uses various learning strategies, and (3) monitor and evaluates the strategy used for learning. In the study, the score obtained in the 'Scale of Metacognitive Awareness' administered on the selected sample of Secondary School Students is considered as Metacognitive Awareness.

Goal Orientation

Goal Orientation refers to the relevant purposes or aims that individual strive for in achievement settings, and these different purposes or aims are posited to lead to differential performance outcomes (Elliot, Shell, Henry & Maier, 2005).

For the present study, Goal Orientation is defined in terms of certain achievement goals; Viz Mastery, Performance–Approach and Performance-Avoidance Goals which individual adopts in the learning process and these lead to differential performance outcomes. In the study, the scores obtained in the 'Scale of Goal Orientation' administered on the selected sample of Secondary School Students are considered as Goal Orientation. Three main types of Goal Orientation used in the present study are;

1) **Mastery Goal Orientation (MGO)** refers to students' focus or motivation to increase one's knowledge/mastery of task and their desire to acquire new skills.
2) **Performance-Approach Goal Orientation (PAPGO)** refers to students' focus or motivation to perform better than their peers and receiving favourable judgments of ability from others.
3) **Performance-Avoidance Goal Orientation (PAVGO)** refers to students' focus on avoiding the perception of incompetence in comparison to others and avoiding unfavourable judgements of abilities from others.

Learning Styles

Learning Styles is the composite of characteristics cognitive, affective and psychological factors that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment (Keefe, 1979).

For the present study, Learning Styles is defined in terms of Visual, Auditory and Kinesthetic ways of learning preferred by students for accommodating their needs in the teaching - learning process. The scores obtained in the 'Learning Style Inventory' administered on the selected sample of Secondary School Students are considered in this study. Three main types of Learning Styles used in the present study are;

1) **Visual Learning Style (VLS)** is a mode of learning with the use of seen or observed things including pictures, diagrams, demonstrations, displays, handouts, films, charts, maps and circles etc. These learners gain and retain information by seeing it.

2) **Auditory Learning Style (ALS)** is a mode of learning through listening: to the spoken word, of self or others, of sounds and noises. They learn best from lectures, radio, group discussions etc.

3) **Kinesthetic Learning Style (KLS)** is a mode of learning by involving physical experience - touching, feeling, holding, doing and practical hands-on experiences. These learners are more connected to reality either through concrete personal experiences and practice or simulation.

Process Skills in Chemistry

Process Skills in Chemistry are defined as a set of skills that are reflective of the behaviour of scientists, are appropriate to many science disciplines, and are abilities that are broadly transferable to other situations

(Padilla, 1990). In the present study, Process Skills in Chemistry can be defined in terms of a set of Basic and Integrated Skills appropriate to the branch of Chemistry.

Basic Process Skills in Chemistry (BPS).

Basic Process Skills in Chemistry can be defined in terms of a set of basic skills such as Observing, Classifying, Communicating, Measuring, Predicting, Using Number Relations and Inferring which are identified in the subject of Chemistry. The scores obtained in the 'Test of Basic Process Skills in Chemistry' administered on the selected sample of Secondary School Students are considered in this study.

Integrated Process Skills in Chemistry (IPS).

Integrated Process Skills in Chemistry can be defined in terms of a set of complex skills such as Formulating Hypotheses, Controlling Variables, Interpreting Data, Analyzing and Generalizing which are identified in the subject of Chemistry. The scores obtained in the 'Test of Integrated Process Skills in Chemistry' administered on the selected sample of Secondary School Students are considered in this study.

Secondary School Students

Secondary School students are the students who are studying in VIII, IX and X standard of recognized schools in Kerala. In the present study Secondary Schools Students are the students studying in IX and X standards of Government and Aided schools of Kerala.

Variables Selected for the Study

The main intention of the present study was to find out the influence of Metacognitive Awareness, Goal Orientation and Learning Styles on Basic and Integrated Process Skills in Chemistry. Hence the present investigation includes the following Predictor and Criterion Variables.

Predictor Variables

The Predictor Variables selected for the study are:

- Metacognitive Awareness
- Goal Orientation
- Learning Styles

Criterion Variables

The main Criterion Variable selected for the study was Process Skills in Chemistry of Secondary School Students. In the present study the Process Skills in Chemistry is divided in to two levels such as Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry and treated as the separate Criterion Variables.

Classificatory Variables

Classificatory variables selected for the presented study are as follows.

- Gender
- Locality of the Institution
- Type of Management of the Institution

Objectives of the Study

The study examined the influence of selected Predictor Variables namely, Metacognitive Awareness, Goal Orientation and Learning Styles on Process Skills in Chemistry of Secondary School Students. In order to accomplish the major objective, the study has the following specific objectives.

The specific objectives formulated for the study are following:

1. To find out the level of Metacognitive Awareness among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
2. To find out the extent of Goal Orientation among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
3. To find out the Learning Style Preferences of Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
4. To study whether there exist any significant differences in the mean scores of Metacognitive Awareness and its Levels between the subsamples based on Gender, Locale and Type of Management of the Institution.
5. To study whether there exist any significant differences in the mean scores of Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO) and Performance-Avoidance Goal Orientation (PAVGO) between the subsamples based on Gender, Locale and Type of Management of the Institution.

6. To study whether there exist any significant differences in the mean scores of Visual Learning Style (VLS), Auditory Learning Style (ALS) and Kinesthetic Learning Style (KLS) between the subsamples based on Gender, Locale and Type of Management of the Institution.

7. To study whether there exist any significant differences in the mean scores of Basic Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

8. To study whether there exist any significant differences in the mean scores of Integrated Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

9. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

   (ii) To estimate the Multiple Correlation (R) between significant predictors and the Criterion Variable, Basic Process Skills in Chemistry.

   (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Basic Process Skills in Chemistry for the Total sample and subsamples based on Gender, Locale and Type of Management the Institution.

10. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

    (ii) To estimate the Multiple Correlation (R) between significant predictors and the Criterion Variable; Integrated Process Skills in Chemistry.

    (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Integrated Process Skills in Chemistry for the Total sample and the subsamples based on Gender, Locale and Type of Management the Institution.

Hypotheses of the Study

In research methodology hypotheses formulation is essential for getting an idea regarding the expected outcomes of the study. Hypotheses provide a clear path to the investigator and delimit the study into some relevant issues of the problem under consideration.

The present study is designed to test the following hypotheses:

1. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Gender.
2. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Locale of the Institution.

3. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Type of Management of the Institution.
4. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Gender.
5. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Locale of the Institution.
6. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Type of Management of the Institution.
7. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Gender.
8. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Locale of the Institution.
9. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Type of Management of the Institution.

10. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Gender.

11. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Locale of the Institution.

12. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Type of Management of the Institution.

13. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Gender.

14. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Locale of the Institution.

15. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry for the sub samples based on Type of Management of the Institution.

16. Metacognitive Awareness, Goal Orientation and Learning Styles will be the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

17. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Basic Process Skills in Chemistry

for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

18. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Basic Process Skills in Chemistry for the Total sample and the subsample based on Gender, Locale and Type of Management of the Institution.
19. Metacognitive Awareness, Goal Orientation and Learning Styles will be significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
20. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
21. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Integrated Process Skills in Chemistry for Total sample and subsample based on Gender, Locale and Type of Management of the Institution.

Methodology

The methodology of the present study is outlined as the following:

Sample Selected for the Study

Secondary school students were selected as the sample for the present study. Due representation was given to strata such as Gender, Locale and Type of Management of the Institution. Sample was drawn from six districts of Kerala namely Kannur, Kozhikode, Malappuram, Thirssur, Kollam and Palakkad districts covering north, south and central regions of Kerala. Sampling Technique used for the selection of sample was Stratified Random Sampling. Data was collected initially from 1010 secondary school students. The incomplete response sheets are rejected and the sample size was reduced to 980.

Tools Used for the Study

For the present study, the investigator used five tools which were constructed and standardised by the by the investigator with help of the supervising teacher. The tools used were found to possess of satisfactory reliability and validity. Tools used for the present study are the following:

Scale of Metacognitive Awareness - SMA (Hameed, Meharunnisa & Sabna, 2014).

This scale is intended to assess the Metacognitive Awareness of Secondary School Students. It is a three point scale constructed and standardised by the investigators. The tool consists of 66 items. Components of Metacognitive Awareness include Viz., Knowledge of Self, Preparation and planning for learning, Conditional Knowledge and Selecting and using learning strategies. The items in the inventory can be responded as 'Always', 'Sometimes' and 'Never' which yield a score of 3, 2 and 1 respectively. The tool includes positive and negative items. Reliability and validity of the tool was established by the investigator.

Scale of Goal Orientation – SGO (Hameed & Meharunnisa, 2014).

This Scale of Goal Orientation (SGO) is used to find out the type of goals adopted by Secondary School Students in achievement situations. It is a five point scale constructed and standardised by the investigators. The tool consists of 61 items from three categories of Goal Orientation Viz., Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation dimensions. The items in the inventory can be responded as 'strongly agree', 'Agree', 'Not decided' 'Disagree' and 'Strongly Disagree' which yield a score of 5, 4, 3, 2 and 1 respectively. Reliability and validity of the tool were established.

Learning Styles Inventory – LSI (Hameed & Meharunnisa, 2014).

Learning Styles Inventory (LSI) is intended to investigate the most appropriate mode of learning preferred by Secondary School Students. It is a three point inventory constructed and standardised by the investigators. The tool consists of 75 items. Categories of Learning Style are Visual, Auditory and Kinesthetic styles of learning. The items in the inventory can be responded as 'Always', 'Sometimes' and 'Never' which yield a score of 3, 2 and 1 respectively. Reliability and validity of the tool were established.

Test of Basic Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test is developed to measure the Basic Process Skills in Chemistry of the Students in Secondary Schools. The seven Basic Process Skills measured by this test consist of; Skill of Observing, Skill of

Comparing/Classifying, Skill of Communicating, Skill of Using Number Relations, Skill of Measuring , Skill of Predicting, and Skill of Inferring. The draft test of Basic Process Skills consists 60 multiple choice questions.

Test of Integrated Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test is developed to measure the Integrated Process Skills in Chemistry of the Students in Secondary School Students. The five Integrated Process Skills measured by this test are; Skill of Interpreting Data, Skill of Analysing, and Skill of Generalising. The draft test of Integrated Process Skills consists 43 multiple choice questions.

Statistical Techniques Used

The main statistical techniques employed for the analysis of data in the present study are the following.

Percentage calculation.

Percentage Analysis was utilized in the study to find out the level of Metacognitive Awareness for the Total sample and the relevant subsamples.

Mean difference analysis.

Mean difference Analysis was employed by the investigator to study the significant difference in the mean scores of the Predicator Variables and the Criterion Variables based on Gender, Locale and Type of Management of the Institution.

Multiple regression analysis.

Multiple Regression Analysis was made use of by the investigator to identify the significant predictors and their relative efficiency (individually and collectively) in predicting the Basic and Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

Scope and Limitations of the Study

Science is not an isolated subject of thought, it crosses into all subjects. Among different science subjects, Chemistry is an alluring subject, many of the students find problems in grasping the concepts because of poor teaching methods, cramped syllabus, absence of practical activities and it is exceedingly dull and dreary. When the teachers allow students to conduct and explore on Chemistry experiments in the laboratory, their performance and attitude towards Chemistry changed. If the teachers, forced to listen students by simply speaking, they do not show a positive attitude and interest. This shows that students prefer to do hands-on activities or student centred learning rather than teacher centred learning (Yunus & Ali, 2013). Therefore when the classrooms excelled with different process skills, it will definitely impact on their performance. Many researches confirmed the fact that first and foremost skills needed to develop through science is the science process skills (Harlen, 1999; Beaumont-Walters & Soyibo, 2001; Harrell & Bailer, 2004; Monhardt & Monhardt, 2006).

The present curriculum and instructional methods in India is based on the cognitive learning theories where learning is the product of experiences and social discourse. Hence the factors affecting the ways and means of learning outcomes must be of great importance. The main purpose of the present investigation was to explore how the selected Predictor Variables i.e. Metacognitive Awareness, Goal Orientation and Learning Styles influence Basic and Integrated Process Skills in Chemistry of Secondary School Students. The Predictor Variables identified by the investigator are very relevant because these are the major predictors of academic success. Through the study, the existing level of Metacognitive Awareness, Goal Orientation and Learning Styles among Secondary School Students of Kerala state is revealed. The study provides an evaluation on the existing level of Science Process Skills of Secondary School Students. Hence the findings of the study would be of great use to Secondary School teachers, educationists and curriculum planners. It is expected that the findings of the study will help curriculum planners to make the needed changes in the content of science text book and refinement of curriculum.

For the present study, the variables are measured using appropriate tools constructed and validated by the investigator with help of the supervising teacher. In order to make the study more objective and precise the required data were collected from 980 secondary school students of Kerala State using Stratified Random Sampling Technique. Since the sample of the study comprises of various sections form different districts, the result can be generalised for whole Kerala. Even though every attempt was made to make the study as precise and generalisable as possible, there are certain limitations likely to occur in the study.

The following limitations are identified for the present study:

- The present study was limited to study the influence of selected variables on Process Skills in Chemistry. Review suggested that there are many other factors affecting Process Skills in Chemistry. The effects of other relevant variables are not taken into consideration.

- Categorisation of Process Skills was done by different authorities and it includes so many types. In the present study the investigator used only 12 Science Process Skills (Basic and Integrated) that are mentioned in the curriculum frame work (2005).

- The selection of Criterion Variable has been restricted to Basic and Integrated Process Skills in 'Chemistry' only. The study can be tested on Process Skills in other relevant subjects.

- Population of the study was limited to standard IX and X students of Government and Aided Secondary Schools only. Eventhough the population of the present study represents Secondary School Students of Kerala, the sample of the study was confined to six districts of Kerala viz., Kollam, Thirssur, Malappuram, Kozhikode, Kannur and Palakkad due to practical reasons. The sample is not a state wide one

- The present study followed survey design and examined the influence of Predictor Variables such as Metacognitive Awareness, Goal Orientation and Learning Styles on Basic and Integrated Process Skills. The study can be conducted with other relevant independent variables too.
- In the study, Process Skills are assessed by test items. But if it is measured through any other methods like observation or direct methods more reliability could have been ensured.
- If the study follows an experimental design by using process oriented method as a manipulated variable and its effects could have been observed directly on independent variables.
- In order to study the group differences, the classificatory variables selected for the study were Gender, Locality and Type of Management of the Institution. The study can be conducted by considering other relevant classificatory variables like level of intelligence, standard of school, parental education, Socio-economic status.
- In this study, science education standard is assessed only by one variable, Process Skills. Relevant variables other than Process Skills can be studied.

Despite the limitations mentioned, all the plausible measures were taken by the researcher to make the present study generalisable and comprehensive to a great extend. The investigator wishes that the present study will bring a positive reflection to the scientific leaders, educational experts and to the whole academic community to spark upon remedial measures which in turn will help the Secondary School Students to raise their educational standards.

Organization of the Report

The report has been presented in five chapters as follows:

Chapter 1: This chapter of the report presents a brief introduction, need and significance of the study, operational definition of key terms, variables used for the study, objectives of the study, hypotheses of the study, methodology, scope and limitations of the study and organization of the report.

Chapter 2: This chapter deals with theoretical overview of each variable and review of literature associated with each variable.

Chapter 3: Methodology of the study was described in this chapter. It includes design of the study, sample used for the study, detailed description about tools used for the study, data collection procedures, scoring and consolidation of data and statistical techniques used for the analysis of data.

Chapter 4: Details of the statistical analysis of the data along with discussion and interpretations of the results are presented in this chapter.

Chapter 5: This chapter provides a summary of study along with major findings, tenability of hypotheses, conclusion, educational implications derived and suggestion for further research.

CHAPTER 2

Review of Related Literature

- *Theoretical Overview of the Variables*
  - *Metacognitive Awareness*
  - *Goal Orientation*
  - *Learning Styles*
  - *Science Process Skills*
- *Review of Related Studies*
  - *Studies on Metacognitive Awareness*
  - *Studies on Goal Orientation*
  - *Studies on Learning Styles*
  - *Studies on Science Process Skills*

Review of related literature gives detailed resume about the prior researches and overall information about the theoretical and practical studies, research patterns adopted and different tools for measuring the variables selected for the study. Review also stimulates the researcher deep in the knowledge about the selected variables and it also helps in avoiding duplication.

In the present study, the investigator has made an attempt to explore the theoretical framework of the Predictor Variables viz., Metacognitive Awareness, Goal Orientation, Learning Styles and of the Criterion Variables Basic and Integrated Process Skills in Chemistry selected for the study. The investigator has made extensive effort to examine and analyse various studies conducted in the educational settings with above mentioned variables up to the year 2017. Hence the present chapter composed of two major sections. The first section deals with theoretical background of the four variables and second section deals with the various empirical studies carried out by other researchers by using the variables under consideration. The organization of the chapter is described in the following manner.

Theoretical Overview of the Variables

Metacognitive Awareness

Goal Orientation

Learning Styles

Science Process Skills

Review of Related Studies

Studies on Metacognitive Awareness

Studies on Goal Orientation

Studies on Learning Styles

Studies on Science Process Skills

Theoretical Overview of the Variables

This section details mainly about the major theoretical background of Predictor Variables namely; Metacognitive Awareness, Goal Orientation, Learning Styles and the Criterion Variables; Basic and Integrated Process Skills in Chemistry.

Theoretical Overview of Metacognitive Awareness

Metacognition is a significant psychological construct in the field of teaching and learning process. The inclusion of metacognition in the developmental process of learner especially in school settings is needed to be essential for easy comprehension and for enhancing achievement in various educational settings. Flavell (1979) referred that better schools must be "hotbeds of Metacognitive Development" because schools are the landscape for conscious self learning. Schraw and Moshman (1995) presented metacognition as a feature which encourage the students to "step back" from different ideas produced by themselves and help them to reflect and think upon them. White and Gunstone (1989) put forward that meaningful learning in science subjects can be easily attained by empowering students to take control of their learning with the development of metacognitive skills. Similarly researchers argued the importance of acquisition of metacognitive skills through the instructional process encompassing complex problem solving in different areas particularly in science subjects.

Origin of Metacognition.

Research in the field of Metacognition is started by Flavell and he coined the term "Metacognition" in 1970's as a progressive concept, found to be originated from the concept of Meta-memory (Flavell, 1971). Flavell identifies metacognition as a "shift in thinking or thinking on thinking". Literature studies on metacognition shows its definitions as 'Knowledge and cognition about cognitive phenomena' or simply 'cognition about cognition' or 'thinking about one's own thinking. Metacognition is generally related to individuals' knowledge, awareness and control of the various processes by which they learn (Brown, 1987; Garner & Alexander, 1989). According to Gunstone (1992) meta-cognitive learners are thought to be characterized by ability to recognize, evaluate and reconstructing existing ideas at the needy situations. Reviews regarding the origin of metacognition recognized that the self regulated process are prevalent in older times and advocated by the earliest educationists like Dewey (1910) and Thorndike (1914) before the emergence of the concept metacognition in the areas of reading and writing (Brown, 1987). Piaget (1970) remarked the importance of cognitive stability and which put a profound influence upon Flavell for the development of metacognition. Dependence of social and cultural interactions on cognitive development was considered by Vygotsky and

David Ausbel worked on the area of influence of previous knowledge and its interactive effect on the expansion of cognition (Powell & Kalina, 2009). So it is evident that for long years, several developments were took place in the field of cognitive theories and it shows the importance of this concept.

Definition of Metacognition.

The concept of Metacognition encounter numerous definitions reached from the wide array of researches. The most common description for metacognition is "knowledge concerning of one's own cognitive processes and regulation of these cognitive activities in the learning process" (Flavell, 1979 & Brown, 1987). Here, "Meta" refers to "a change of position, a sense of going beyond the ordinary level" or "to a second order or higher level thinking" and "cognition" refers to the process of knowing or thinking. Baker and Brown (1984) defined the metacognitive knowledge by explaining the difference between static and strategic knowledge. Static means what people able to verbalise or talk about their own cognition; where as strategic knowledge consist of various strategies that are used by people are able to regulate their cognition. These strategies includes planning of the work which is going to execute, prediction of time needed for the completion of a particular task, guessing of the anticipated answer before reaching real solution and monitoring of the progress as whether the goal is accomplished or not.

Modified definition given by Baker and Brown (1984) about the concept of metacognition was the "awareness of what skills, strategies and resources are needed to perform a task effectively; and the ability to use self regulatory strategies to ensure the successful completion of a task". Another definition by Pintrich (2002) is that "students becoming more knowledgeable of and responsible for their own cognition and thinking". Weinert and Kluwe (1987) viewed this concept as 'Executive Processes'; which requires conscious attention to one's thinking and making changes to thinking by knowing self cognitive processes. Hacker, Dunlosky and Graesser (1998) differentiated metacognition as a tool for creating successful learners by allowing people to take charge of their own learning. More comprehensive definition given by Gourgey (2001) is "awareness of how one learns; awareness of when one does and does not understand; knowledge of how to use existing information to reach a goal; ability to infer the cognitive needs of a particular task or problem; knowledge of what strategies or techniques are used and for what purposes they are used; and assessment of one's progress both during and after performance".

Components of Metacognition.

Conceptualization of Metacognition shows that it is having two primary components namely Knowledge of Cognition/Metacognitive Knowledge and Regulation of Cognition/ Metacognitive Regulation (Flavell, 1979; Brown, 1987; White & Frederiksen, 2005).

1) Metacognitive Knowledge.

Metacognitive knowledge is "knowledge about what factors act and interact in what ways to affect the course and outcome of cognitive enterprises" (Flavell, 1979). In other words, a person's knowledge about one's own cognitive processes, strategies, cognitive abilities as well as about others as learners and about the requirements involved in the learning process acquired consciously or unconsciously in formal or informal settings. This knowledge includes what strategies can use? How to use? and when to use? (Baker & Brown, 1989; Schraw, 1998). Metacognitive knowledge is an essential component of Metacognition because it provides a general awareness regarding various learning strategies, method of using strategies and the suitable situations in which these strategies can be applied. Flavell (1971, 1979) divides metacognitive knowledge into three categories: (a) person knowledge (knowledge of person variables), (b) task knowledge (task variables) and (c) strategic knowledge (strategy variables).

(a) Person Knowledge.

It is the knowledge regarding an individual's overall understanding of how people process information and beliefs about what factors affect their own learning. So the category of person knowledge comprised of knowledge about the self in relation to both motivational and cognitive aspect of learning, knowledge of one's strength and weakness and awareness regarding different type of strategies they are likely to relay on different situations. Pointing to the beliefs one has about oneself and others as cognitive processors (learners), Flavell (1979) includes two dimensions of person knowledge: intra individual differences and inter individual differences (knowledge of personal styles, abilities etc) and universal of cognition (knowledge of human attributes influencing learning). Therefore this category encompasses everything that a person believes about his nature and nature of other people as cognitive processors. This category is linked with task category.

(b) Task Knowledge.

Task knowledge or knowledge of task variables means that one is aware about the nature and character of a task, how to manage this task successfully, and the probability of one's success. Furthermore, one recognizes the degree of complications involved while solving the task/problem under consideration. According to Wenden (1998), task knowledge comprises of four aspects: Knowledge about the objective of a task (what is the main purpose in executing the task under consideration?), Knowledge about demands of task (what resources and steps are necessary and what is the degree of difficulty involved?), and Knowledge about the nature of the task (what kind of learning is it?). In this stage people use their previous knowledge for comparing the task with earlier situations, seek requirements needed to complete the task, predict whether they can complete the task or not. So in this category the person collect all information required to complete a task.

(c) Strategic knowledge

Strategic knowledge or knowledge about strategy variables refers to the awareness and application of metacognitive strategies while attending to a task. An individual knows what are the strategies and their usefulness to the situation is already known to them (Wenden, 1998). Strategy category includes the use of different strategies to reach the goals, monitoring the progress of the task, evaluate and think about the alternative strategies. Metacognitive strategies are "general skills through which learners manage, direct, regulate, guide their learning, i.e. planning, monitoring, and evaluating" (Wenden, 1998). This step ensures whether they reached the objective or not.

Brown (1987) has categorized metacognitive knowledge into declarative, procedural and conditional knowledge. It includes three different kind of knowledge namely Declarative Knowledge, Procedural Knowledge and Conditional Knowledge. Declarative Knowledge refers to 'knowing about things and the factors influencing one's performance' (Schraw, 1998, Shraw & Moshman, 1995). For example some students know more about the influence of memory on their performance. Procedural knowledge refers 'knowledge regarding how to do and execute things'. Learners with procedural knowledge can use their own skills, use and sequence various strategies effectively for solving a task. Conditional knowledge refers to 'why and when to apply various cognitive actions'. Learners can compare the relative effectiveness of strategies and use wisely.

2. Regulation of cognition.

Regulation of cognition is the second component of metacognition. Metacognitive regulation can be defined as the ability of the individual to use metacognitive knowledge strategically for achieving goals. Regulation of cognition is essential because without this the learners cannot able to use, apply and control the cognitive strategies to reach the goals (Flavell, 1979). Literature shows that this ability is affected by different skills, like planning, Monitoring and Evaluation of metacognitive processes (Jacobs and Paris, 1987; Weinert & Kluwe, 1987, Shraw and Moshman, 1995).

a) Planning.

It includes the selection of suitable resources and the allocation of these resources in suitable situations that affect the performance (Millar, 1994). In this situation one can predict the time, type of strategies and their selection for bringing good results.

b) Monitoring.

It includes the careful monitoring of each and every stage followed by the person to accomplish the learning goal (Jacob & Paris, 1987). In this stage, the pupils periodically ask whether the selected strategies are appropriate and point out the errors and obstacles in the selected strategies.

c) Evaluation.

In this step pupil assess the accuracy and adequacy of result, assessing goal achievement and evaluating efficiency of plan and procedures used previously (Jacob & Paris, 1987). Metacognitive evaluation refers to judgments made about one's thinking power, abilities and limitations employed in a particular situation or judgement of self-attributes. Metacognitive evaluation stimulates little awareness of the individuals thinking process and anticipates the regulation of those processes.

In addition to these two major components, developments in this field show that metacognitive knowledge requires competence (Corsale & Ornstein, 1980) and it makes an overall judgement of the product of the learning experience. It helps learners to take conscious decision regarding selection and use of strategies leading to the enhancement of one's metacognitive knowledge (Flavell, 1979; Schunk & Ertmer, 1999). An outline of the classification metacognition is presented in the Figure 1.

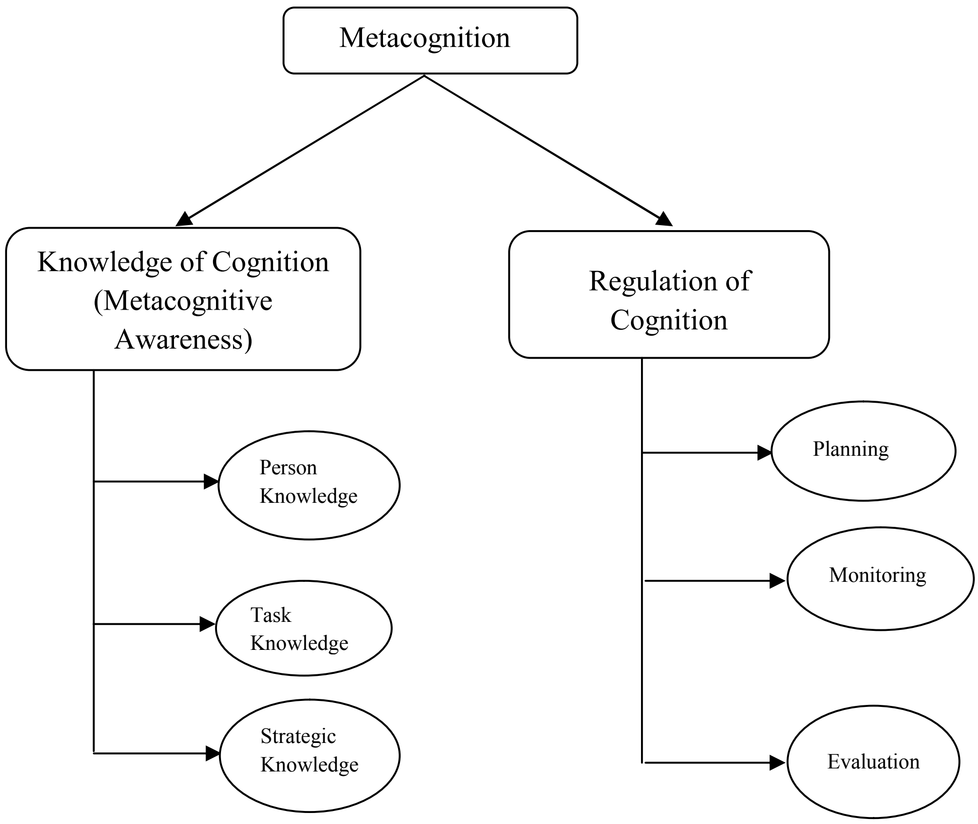


Figure 1. Classification of Metacognition

Importance of Metacognition.

Metacognition is a significant part of human abilities and it help learners consciously aware of their learning process; understand the various situations in which these capacities can be effectively used and thinking on various mental processes involved in it (Paris & Winograd, 1990). On the other hand, Schoenfeld, (1987) explained that metacognition increases the meaningfulness of classroom learning while many consider that it enables students to advantage from teaching (Carr, Kurtz, Schneider, Turner & Borkowski, 1989; Zile-Tamsen, & Marie, 1996) and influences the use and maintenance of cognitive strategies. The concept of metacognition has provided insight towards cognitive processes of learning and the discrimination between successful and less successful students in learning. The metacognitive developments in children can be improved through guided thinking, selection of sensible strategies and progressive evaluation of goals.

Functions of Metacognition.

Wilson (1999) expanded the concept of metacognition by giving stress to three major functions; awareness function, evaluation function and regulation function. Functions related with Metacognitive Awareness includes individuals' awareness about their current capacity and position in learning process, of their content specific knowledge related to the task, of their knowledge about learning strategies, and what is required in particular problem solving situations (Wilson & Bai, 2010). Halter (2005) concluded that Metacognitive Awareness includes the following abilities:

(i) Conscious knowledge of current position

(ii) Formulating goal of learning

(iii) Use of personal resources (textbooks, access to library, access to computer or a quiet study area) as well as other strategies

(iv) Think about the need or use of the task

(v) Evaluation of performance

(vi) Ways of evaluation

(vii) Effect factors like motivation, anxiety and attention on learning

Hence from the above discussions, it may be summed up that metacognition is essential for learners as it helps them to recognize their needs to adapt learning activities according to the demands of task. It enriches the learners with information necessary to design their own learning plans. Metacognitive skills shift the responsibility of learning from teachers to students and produce more independent, strategic learners. It helps students in developing the ability to monitor and regulate their cognitive activities while learning and performs several other functions. Therefore, the importance of helping students develop a repertoire of metacognitive strategies has significance for learning (Bransford, Sherwood, Vye, & Rieser, 1986) and studies suggest that the development of metacognitive skills begins early in life and develops throughout adolescence (Brown, 1987; Garner & Alexander, 1989), teaching practices that encourage high school students to sharpen these abilities hold promise.

Assessment of Metacognitive Awareness.

The historical background of metacognition is paralleled by an understanding about the different assessment methods that are fit to describe metacognition. Metacognition is assessed by using different methods like; questionnaire on metacognitive awareness (Pintrich & De Groot, 1990), self reporting measures like interviews or inventories

(Zimmerman & Martinez-Pons, 1990), the analysis of thinking-aloud methods (Veenman, Elshout & Groen, 1993), observation method (Veenman & Spaans, 2005), stimulated recall (Veenman, Van Hout-Wolters & Afflerbach, 2006) etc. Literature reviews in the field of assessment revealed that multimethod design can be used and it may be an effective solution for overcoming the short comings of individual instruments.

One of the most valid, reliable and widely used tools was Metacognitive Awareness Inventory (Schraw & Dennison, 1994), it is a self reporting Questionnaire consisted of 52 items and it can be used for graduate and under graduate students. This inventory was based upon the two components knowledge and regulation of cognition identified through factor analysis method. Later this Metacognitive Awareness Inventory was modified and named as Junior Metacognitive Awareness Inventory, which is used for assessing the metacognition among children between the grades 3 to 9 by Sperling, Howard, Miller & Murphy (2002).

Everson and Tobias (1998) used a calibration approach by focussing on accuracy of knowledge monitoring, in which the subjects are asked to predict their knowledge in vocabulary using a word list to investigate the relationship between the ability to estimate knowledge and the performance on a related task. This kind of approach has been employed by other authors also (Vadhan & Stander, 1994). This assessment method is having a limited scope and little studies are supporting this type of measurements. Another tool used to assess the metacognitive ability while solving the Chemistry problems was Metacognitive Activity Inventory developed by Cooper and

Sandi-Urena (2008). It is a 27 item self reporting questionnaire and found to be reliable and valid. According to review conducted by common chemical education research show that the systematic and quantitative assessment of metacognition in chemistry context is absent.

Theoretical Overview of Goal Orientation

The concept of Goal Orientation was emerged as a result of socio - cognitive representations of motivation and for the past two decades it was one of the major concerns of many educational researchers (Elliot & McGregor, 2001; Elliot & Murayama, 2008; Pintrich, 2000). Motivation was perceived by behaviourists as well as cognitivists; and cognitive perspective directed this concept as an internal motivation oriented with achievement, attributions and beliefs which are factors or situations. The framework of motivational orientations in schools was enhanced by the cognitive perspective and it is mainly linked with three functions; (a) energizing or activating behaviour for engaging students learning (b) directing behaviour by answering why one course of action is chosen over another, and (c) regulating persistence of behaviour by giving explanation to the question why students persist toward goals (Ford, 1992; Alderman 2013).

Among different motivational theories, achievement motivation is based upon the Socio-cognitive Theory of Motivation and which is conceptualised as purpose or cognitive- dynamic focus of competence related acts (Maehr & Midgley, 1991; Elliot, 1997). According to Dweck and Elliot (1983),"Goals are cognitive representations of the different purposes students may adopt in different achievement situations." Achievement Goal Orientation refers to "the purposes or reasons an individual is pursuing an achievement task, most often operationalized in terms of academic learning tasks" (Pintrich, 2000; 1993). Achievement goals guide behaviour of students and cognition while engaging in academic tasks. Dweck & Legget (1988) pointed that goal orientations are related with different patterns exhibited by students when they attend, interpret and respond to various academic tasks. The term achievement goal orientation represents more general goals towards a particular task, which is being influenced by several factors such as purposes, competence, success, ability, effort, errors, and standards (Pintrich, 2000). Hence goal orientations reflect a well defined system, theory for approaching, involving and assessing one's performance in different achieve mental contexts.

History and Meaning of Goal Orientation.

According to the behaviourists, motivation is concepts which can be driven out by providing incentives (Middleton & Spanias, 1999) and the cognitivists viewed motivation as a three component system related with self regulation and value components including goals, expectancy component related with students belief regarding the ability to perform task and an affective component related with emotional approach toward a particular task (Pintrich, 1992; Pintrich & DeGroot, 1990; Pintrich & Schrauben, 1992). But recently motivation was mainly discussed under the socio-cognitive theories and the achievement motivation was cited under this view (Weiner, 1992; Atkinson, 1964; Bandura, 1986). In this theory, achievement goals acquaint individuals for exhibiting competence and organize their behaviours in order to attain the level of competence. For the past two decades one of the most predominant motivational frameworks behind achievement motivation was goal theory (Anderman & Wolters, 2006; Elliot & McGregor, 2001; Elliot & Murayama, 2008; Pintrich, 2000). A goal is an "outcome or attainment in which an individual is striving to accomplish" (Locke & Latham, 1990). Goals are "one of the major determinants or subject which specifies of how people feel about, react to and cognitively process success or failure" (Ames & Archer, 1998; Dweck, 1986). Wolters (2004) defined achievement goal as "goals or purposes that motivate students within the academic settings".

A series of frame works were developed by different goal orientation theorists based on various research findings. This construct was developed as a result of independent and collaborative works of Ames (1992), Dweck (1992), Elliot (1997), Elliot and Church (1997), Elliot and Harackiewicz (1996), Harackiewicz, Barron and Elliot (1998). Achievement goal theorists focussed upon "intentions or reasons that lead an individual for engaging, selecting and continuing different learning activities" (Meece & Anderman, 2006). Among them initial conceptualisation of goal orientation was done by Dweck and his colleagues in 1980s by conducting research among school children. During that work, Dweck found that children tend to approach activities with two underlying goals; developing ability and demonstrating ability. So children are exhibited by adaptive and mal adaptive patterns of behaviours while engaging in an achievement task (Dweck, 1992).

Achievement goal theorists argued that behaviour are purposeful, intentional and focussed towards the accomplishment of certain specific goals (Nicholls, 1984).

Ames (1992) and Weiner (1986) explained Goal orientations as "combined design of beliefs, attributions, and affects yielding intentions for acts, which is displayed by different ways of approaching, engaging in, and responding to achievement type activities". Hence goal orientations are mainly centred on the group of certain standards that are used by people for evaluating their competence and goals used by them to enhance or expose this competence in different contexts of achievement (Ames, 1992; Eccles & Midgley, 1989; Nicholls, 1984). So the achievement goals are best explained in terms of three reference standards namely 1) Absolute reference means factors necessary for performing task 2) intrapersonal reference means individual's past achievement and 3) normative standard means comparison of performance of others (Elliot & McGregor, 2001; Elliot & Thrash, 2001).

Models of Goal Orientation.

The earliest model of goal orientation was proposed by Dweck (1986) and Dweck and Elliot (1983) and this model comprises *dichotomous classification of Goal Orientation*. Dweck (1986) distinguished two types of goals as Mastery or leaning Goals and Performance Goals. The dichotomous theory of goal orientation was confirmed by other researchers (Nicholls, 1984; Ames & Archer, 1998; Harackiewicz & Elliot, 1993; Harackiewicz &

Sanson, 1991). Nicholls (1984) labelled them as task involvement goals and ego involvement goals. The task involvement goals were indicated by positive patterns of achievement, aim of acquiring ability and intrinsically motivated state; on the other hand ego involvement is linked with non optimal patterns of responses and differentiated sense of demonstrating ability.

In general the earlier works on Goal Orientation agreed that mastery goal orientations are associated with developmental outcomes such as expenditure on efforts; go in for challenging works, intrinsic motivation, high degree of persistence and use of effective strategies for learning (Jagacinski & Nicholls, 1987; Ames & Archer, 1988; Dweck & Elliot, 1988; Meece, Blumenfeld, & Hoyle, 1988). So literature in the field of mastery goal orientations was consistent and in accordance with above findings. But regarding the other goal, some researchers questioned the consistency of the finding that performance goals are maladaptive (Harackiewicz & Elliot, 1993; Harackiewicz & Sanson, 1991). Researchers indicated that performance goals sometime show positive consequences such as positive academic self-concept, effort expenditure on studying and performance attainment (Elliot, McGregor, & Gable, 1999; Wolters & Pintrich, 1996). As a result of this the dichotomous frame work was revised by incorporating approach-avoidance dimensions.

To remove the diversity in findings, Elliot (1999) introduced the *trichotomous frame work* by categorising the performance goals in to approach, avoidance dimensions. The distinction between approach-avoidance dimensions in motivation has long history in intellectual thought in general and scientific psychology in particular. According to Lewin (1935), approach motivation may be defined as the categorization of behaviour by or the direction of behaviour towards, positive stimuli (subjects, events, possibilities), whereas avoidance motivation may be defined as energisation of behaviour by or the direction of behaviour away from, negative stimuli (objects, events, possibilities). Approach and avoidance concepts and constructs have been utilised across a diversity of scholarly disciplines, theoretical traditions and empirical content areas. Here, *mastery orientation* was focused on mastery of the task and increasing competence; *performance-approach orientations* are characterized by demonstrating ability and attaining normative competence; and *performance-avoidance* was indicated by avoidance of looking incompetent or avoiding normative incompetence (Elliot & Church, 1997; Elliot & Harackiewicz, 1996; Skaalvik, 1997). So according to this model, mastery and performance–approach goals include adaptive behaviour patterns like academic improvement through normative competence, whereas performance-avoidance goals incorporated potential negative outcomes. Elliot (2005) recites from many literature that performance-approach shows fewer adverse effects and performance-avoidance goals are shown by more negative consequences.

Pintrich (2000) extended the trichotomous model of goal orientations by incorporating approach- avoidance dimensions for mastery orientations as well. According to Pintrich (2000) "mastery avoidance gaols entails striving to avoid losing one's skills and abilities or (having their development stagnate), forgetting what one has learned, misunderstanding material, or leaving a task incomplete". Hence in this model, mastery avoidance orientations focus on avoiding misunderstanding or not mastering the task and they are using standards of not being wrong or not doing incorrectly. Mastery approach orientation focuses on the mastery of the task, learning, understanding and they use standards of normative i.e. don't be worst, get the lowest grade or be the lowest. So from the dichotomous model of achievement goal orientation, mastery- avoidance goals were supposed to be less prevalent than other three dimensions and this mastery-avoidance orientation not widely studied and very limited in achievement goal literature. So this study is mainly based on trichotomous model of achievement goals, which is the most common conceptualisations used in the literature.

There are some other types of goals which took a great deal of attention of the goal theorists in literature as well. These are *work avoidance* (Meece, Blumenfeld, & Hoyle, 1988; Nicholls, 1989; Nolen, 1988), *extrinsic goals* (Midgley et al, 1998; Pintrich & Garcia, 1991), and *social goals* (Urdan & Maehr, 1995; Wentzel, 1989). In work avoidance goals, individuals try to get away with things by placing as little effort as possible into the task. Individuals with extrinsic goals strive to get a reward or avoid a penalty. In social goals, individuals try to establish or maintain relationships with other people. There are various types of social goals including social approval goals, social status goals, and affiliation goals. Since the focus of the aforementioned goals is not on competence, these goals do not demonstrate the achievement goals. Thus, none of these goals should be taken into consideration as probable contributions to the achievement goal approach (Elliot & Thrash, 2001).

Meaning of Mastery and Performance Goal Orientations.

In academic settings students approach learning with different goals in mind, this may be either for improving the performance; or having first among the classmates. The goals adopted by children organise the learners is a way of interpreting and reacting to various events.

Mastery Goal Orientation (MGO).

Mastery goal orientation can be defined as the goals in which individuals tend to develop one's abilities, mastery of new tasks or skills and seeking challenging activities. The criterion of success was self improvement and they are self satisfied. People who hold learning or mastery goals want to increase their abilities on performing a task or increase their knowledge of a subject and anticipate this to be achieved by hard work, spend more time and are more risk taking. These learning goals are also known as tasks goals or mastery goals (Meece, Anderman & Anderman, 2006). In addition they are using self referential standards for defining success versus failure. While engaging challenging tasks, mastery oriented students purposefully pay attention, thinking carefully and using previous strategies for solving task (Anderman & Anderman, 2010). In addition mastery oriented students differ from performance oriented in terms of efforts utilised and strategies used. Students under this have positive attitude, monitor their own comprehension, and use more suitable strategies and associate already learned materials with newly learned ones (Lynch & Dembo, 2004). This group generally use cognitive strategies and they are engaged in learning even in the absence of external rewards.

Performance Goal Orientation.

Performance goals are the goals in which individuals who are oriented basically with demonstrating their ability (or concealing a perceived lack of ability) by outperforming others, particularly if success is achieved with little effort. Performance goals are generally regarded as ego dependent or ego involved. They show more preference to demonstrate and validate their own competence by seeking favourable judgments and avoiding negative judgments from others. They are using normative standards for defining success versus failure. They are mainly concentrated to secure high marks or grades in examination and treat it as a basis of demonstration. Dweck and Legget (1988) argued that students with performance orientations while seeking challenging situations may lose their efficacy belief, and shows withdrawal from the effort. If they obtain a negative judgement they are disturbed in their concentration. Performances prove goal orientation as the "desire to prove one's competence and to gain favourable judgments about it". Persons with performance approach orientation seek positive reinforcement and feedback and they don't want to put forth a lot of effort unless they will be positively evaluated, and tend to avoid tasks were they may make mistakes and therefore be poorly evaluated (Vandewalle & Brett, 1999). Avoid performance as the "desire to avoid the disproving of one's competence and to avoid negative judgments about it”. The performance avoid orientation represents a desire to avoid instances of low performance. Persons with performance avoid orientation focus on avoiding situations in which they will receive evaluations or risk demonstrating. They have lack of confidence and fear of failure are more (Vandewalle, 1999). Regarding the effort and use of strategies, performance oriented students are more concentrated on rote learning of the materials and primary method is the simple memorization of learned things. They are very rarely engaged in problem solving and critical thinking processes. They do not make a self evaluation of their own performance rather they are employing short cut method for learning. This group generally follows surface strategies which doesn’t need higher processing of information.

Importance of Goal Orientation.

Achievement goal orientation is a one of the main components which directing individuals by making them efficient in academic tasks and it is linked with different achievement related outcomes. Alderman (2004) proposed that achievement goal orientation was a prominent factor affecting achievement behaviour. Also, Ames and Archer (1988) referred that academic performance was influenced by goals adopted by students and it will influence cognitive engagement, motivation and academic success. Literature review reflected that mastery goals are linked with positive desirable outcomes of education such as use of deep learning strategies, persistence if the outcome may be negative and more interest towards task (Elliot & Dweck, 1988; Harackiewicz & Elliot, 1988). In contrast, performance orientations are more favourable in educational settings which are given importance to competitions (Harackiewicz & Elliot, 1998; Anderman & Anderman, 2006). Performance avoidance orientations are negatively related with academic achievement (Middleton & Midgley, 1997).

Various researchers in the field of Goal Orientation proved that this construct was influenced by various personal factors like ability beliefs (Elliot & Mc Gregor, 2001), self efficacy (Elliot, 1999; Pintrich & Schunk, 2008; Midgley, & Urdan,1996), demographic factors like sex, socio-economic status (Elliot, 1999; Urdan, 1997) and contextual factors (Ames, 1992; Dweck & Legget, 1988; Alderman, 2004). The trichotomous model of goal orientation significantly predicted the Chemistry achievement of under graduate students and the performance approach goal and mastery goals are the strongest predictor and performance avoidance was the negative predictor (Church, Elliot, & Gable, 2001). Uzuntiryaki (2008) tried to determine the predictive utility of intrinsic (mastery) and extrinsic goal orientations on students' Chemistry achievement and the researcher concluded that intrinsic (mastery) goal orientation was a significant predictor of their Chemistry achievement. Another study with the same model proposed that performance-approach goal was a positive significant predictor of the students' Mathematics course grades but performance-avoidance and mastery orientations were not (Wolter, 2004). Sungur &

Senler (2009) identified the contributions of the intrinsic (mastery) and performance goals to the prediction of 10th grade students' Biology achievement in Turkey using Motivated Strategies for Learning Questionnaire (MSLQ) and the study revealed that performance goals negatively predicted the Biology achievement of students, whereas mastery goals failed to predict the same.

Measurement of Goal Orientation.

Review of related works in the area of Goal Orientation show that Goal Orientation was assessed by using various instruments. Most of the studies measured this trait by means of self reporting survey instruments under dichotomous or trichotomous frame works. In such studies the subjects were asked to complete the surveys to identify students' goal orientations in various situations. While some others carried out this at different time points to collect data for examining the variations in goal pattern. The commonly used survey-based tools of goal orientation are described briefly.

Most of the studies used Patterns of Adaptive Learning Survey (Midgley, Kaplan, Middleton, Maehr, Urdan, Anderman, & Roeser, 1998) measure, which contains items regarding students' personal as well as their perceived goal structures in classroom. The Achievement Goal Orientation Questionnaire developed by Elliot and colleagues and by Dweck (1999) is applicable to measure students' goal orientations across a variety of domains. Another instrument developed by Pintrich (2003) as "Motivated Strategies for Learning Questionnaire (MSLQ)" was developed using a social-cognitive theory of motivation and self-regulated learning. This instrument was designed to measure college students' motivational orientations and variety of learning strategies. The MSLQ consists of 81 items under two sections (1) Questions related to motivation and (2) questions related with learning strategies. The MSLQ was constructed to measure the nature of learners motivation and strategies used for learning in given course. It can be administered in normal classroom situation and needs about 20-30 minutes to complete.

Nicholls's conceptualization about Goal Orientation in terms of how students feel about learning while engaged in learning activities. Button, Mathieu and Zajac (1996) developed goal orientation instrument, which is not specific to any context or achievement situation. The items were classified on a 7-point Likert scale, with responses ranging from 1 (strongly agree) to 7 (strongly disagree). The result of factor analysis validated the instrument and produced a measure of goal orientation with sixteen items under mastery and performance orientation. VandeWalle (1997) developed an instrument which classify and assess the construct under three dimensions of learning, performance proves and performance avoid goal orientations. He specifically defined the items of Goal Orientation for applications in work settings. It is a scale with six point likert scale and final validation through factor analysis reduced the tool in to thirteen item scales. Some of the studies used observational methods that can be used by observers to assess goal structures in classrooms (Patrick, Anderman, Ryan, Edelin, & Midgley, 2001).

Theoretical Overview of Learning Styles

The concept of Learning Styles in education is important, because it incorporates all those human attributes which help to determine and characterize a person's preferred approach to problem solving. Researches on identification of factors affecting learning related performance concluded that an understanding about the Learning Style is essential and which provide valuable insight in to academic and other settings (Cassidy & Eachus, 2000). All learning styles theories implicit and support the notion that meeting the learning preference of individuals in the classroom produces significant outcome and enables the learner to imbibe the information more easily and effectively. It is a widely accepted fact that understanding of individuals' manner and approach of learning has an impact on performance and achievement of learning outcomes (Cassidy, 2004). Identification of Learning Style is important in a context, through helping students' to manage and perform tasks with diverse experiences. Literatures in this field clearly support that Learning Style makes the learners more engaging and provoking toward the fruitful developments in the behaviour of students.

Definition of Learning Styles.

All human beings have common biological, psychological and social characteristic in learning process, but they may vary in providing explanation and acquiring information. Various models have been developed so far by different researchers to explain learning style. The concept of learning style was, even though all the definitions conceptualised learning style as individuals preferred personal ways which act as the indicators of cognitive, affective and psychological attributes. One of the comprehensive definitions for learning style was given by Ellis (2001), "A learning style is the consistent pattern of behaviour and performance by which an individual approaches educational experiences". Dunn and Dunn (1993) defines learning style as "the way, in which each learner begins to concentrate on process, internalize, remember and retain new and difficult academic information". Identification and development of learning styles so as to meet the needs of diverse students in classroom is highly essential for making them self sufficient and competent. And the studies on learning style also indicate that it had much impact on performance and contributed highly to students' achievement. Coffield, Moseley, Hall & Ecclestone (2004) pinpointed that learning styles can be beneficial to enhance self awareness and metacognition of students there by reflect upon their strengths and weaknesses in learning.

Models of Learning Styles.

Review of studies in the area of Learning Style signifies the multidimensional models for representing the different aspects. Some of the repeatedly cited models and their classifications are summarised here.

Kolb's Experiential Learning Model (ELM).

David Kolb (1999) proposed a theory of Learning Styles that light on the various processes involved in learning which was originated out of

Experiential Learning Theory. This theory identified four types of learners as Divergers, Assimilators, Convergers and Accommodators. This model explored experiential learning as a cyclical process starting from concrete experience – reflective observation - abstract conceptualisation – active experimentation and finally ending on to further experience. The logic behind this cycle is that immediate concrete experiences provide the learner with a starting point for observations and reflections. As these are understood and assimilated, it can be applied to abstract concepts which can then be tested in new situations.

Honey and Mumford's Learning Style (LSQ).

Honey and Mumford's Learning Style Questionnaire (LSQ) suggest an alternative method for Kolb's Experiential Learning Style Model (ELM) and a later refined version (LSI – 1985). The LSQ is used to identify the relative strengths of four different learning styles such as Activist, Reflector, Theorist and Pragmatist. These four styles correspond approximately to those suggested by Kolb's Experiential Learning model (ELM).

Myers- Brigg Type Indicator (MBTI).

This model classifies the Learning Styles in to four types on the basis of Carl Jung's theory of psychological types. The four dimensions are Extroversion Vs Introversion, Sensing Vs intuition, Thinking Vs Feeling and Judges Vs Perceivers and their combination result in the sixteen types of learning styles. The MBTI dimension of 'feeling/thinking appear to be correlated with the concrete experience/abstract conceptualisation dimension in Kolb's model. Also, Kolb's active/reflective aspect correlates with the extraversion/introversion dimension as measured in MBTI.

Felder-Silverman Learning Style Model.

The proponents of this model suggested that learning styles can be identified by seeking answers to certain question related with students' preference in perceiving information, sensory channels used for perceiving information and organisation and progressing of information. By analysing answer of questions, Felder classified students as Sensing or intuitive, Visual or verbal, Inductive or deductive, Active or reflective and Sequential or global. This model shows similarity with other models as one type of classification with VAK Model, another with Kolb's Experiential Model another tends to draw on personality model as inherent in the MBTI.

Grasha-Reichmann's Learning Style Model (GRLS).

This model focussed on variables related to attitude, class activities, teachers and peers and this utilise an interactive mode with instructors, peers and with learning in general. This model was specifically designed for secondary, college and university students. This model classified the learning styles in to six categories namely free style, avoidance, cooperation, dependent, competitive, and participation.

Dunn and Dunn's Learning Style Model.

This theory proposed the idea of dominant learning style which defines the best way for learning information by identifying essential concepts for further learning. According to Dunn and Dunn's theory five major factors influence one's learning style. They are 1) Environmental preferences such as class design, sound, lighting, and temperature; 2) Emotional preferences such as motivation, persistence, and responsibility; 3) Sociological preferences like learning relations (isolated & team, peer, group); 4) Psychological preferences related to perception, time, mobility; and 5) physiological processes.

Dunn's learning style inventory contains 104 items which produces a profile of learning style preferences and builds on the fact that sensory modes are one of the most influential components of learning. Auditory learners learn mainly through listening, visual learners learn by seeing and kinaesthetic learners learn by touching/ moving. This model falls within the perceptual modality as it is primarily concerned about how we take in information.

Visual-Auditory-Kinesthetic Modalities of Learning Style.

Research suggests that the greater the number of styles students can use, the more successful they will be at learning. Here, the researcher focuses on VAK learning style theories developed by Neil Fleming. Prior to Fleming's work, VAK was in common usage. Based upon the VAK (Visual, Auditory and Kinesthetic) model of learning, VAK learning styles theory was pioneered in 1987 by Neil Fleming. According to VAK theory, every person exhibits unique learning style preferences. VAK learning styles theory is designed to describe how three distinct types of learners process information.

VARK was originally designed to help students. There was no intention of challenging teachers to teach everything four ways. The challenge for teachers, a by-product of VARK, was to ensure that in any three or four teaching sessions they vary their teaching strategies to provide more variety. VAK Learning Style Model is a base for several learning style models including the Dunn and Dunn learning style model and the Gregore's Mind Styles Model. Absorption of information and retention of the learning material depend largely on learner's preferred learning modalities. These preferences paves the way for positive experiences which help the students to transfer the ideas (Sprenger, 2002) and are likely to be advanced learners, achieve higher grades/marks, have more positive attitudes towards their learning and feel responsible manager and owners of their own learning. Use of Perpetual Modality Preference Survey (PMPS) Institute for learning style Research (2003) proves that modality preference can shape the learning of students and thereby help them to become more successful lifelong learners. According to Dasari, (2006) auditory learners are logical, analytical and sequential thinkers. This type of learner may be most successful in traditional classrooms since their style is accommodated in most school tasks. Visual and tactile/kinaesthetic learners, being more global thinkers may run into problems as they are not good with logical, analytical and sequential tasks unless they can see the 'big picture'.

Characteristics of VAK learning Styles (Dunn & Dunn Learning Style model) categorizes Visual, Auditory and Kinesthetic modalities based on sensory perception. Characteristics of these are outlined as follows:

Visual Style.

- Mind sometimes strays during verbal activities
- Finds verbal instructions difficult
- Organized in approach to tasks
- Remembers faces
- Likes to read
- Strong on first impressions
- Memorizes by creating mental images
- Likes drawing and doodling
- May have good handwriting
- Thinks in Pictures and Enjoys using colour
- Easily put off by visual distractions
- Notices details of a thing
- May focus on the big picture
- Use advanced planning and
- Often a quick thinker

Recommended strategies are diagram, graphs, charts, maps, videos, posters, animations, making outlines, make lists, use highlighters, circle words OHP transparencies, news paper, workbooks etc.

Auditory Style.

- Talks to self aloud
- Remembers names

- Outgoing by nature
- May assess people by the sound of their voice
- May be particular about the exact choice of words
- Enjoys music and the sounds of words
- Memorizes by steps in a sequence
- Enjoys talking and listening
- Very aware of rhythm
- May need time to think (discuss it with myself)
- Easily distracted by noises
- May assess a situation on how it
- May have difficulty with written instructions

Listed activities are group work, video conferences, virtual lectures, read to self out loud, oral reports, study groups, group discussions, using audiotape, brain storming, panel discussion and question answer method.

Kinesthetic Style.

- Outgoing by nature
- Likes physical rewards
- Expresses emotions by physical means
- Remembers what they have done rather than seen/heard
- Taps pencil or foot/fiddles with object while studying
- May assess people and situations by what feels right
- Reading is not a priority

- Enjoys handling object
- May find spelling difficult
- Enjoys doing activities
- Likes to solve problems by physically working through them
- Likes to used gestures and touch people while talking to them
- Very good body control, good timing and reflexes
- May need time to think i.e. process the actions involved will try new things- likes to get involved.

Suggested strategies are hands on tests, field trips, role-playing, studying in short blocks, memory games, using flash cards to memorize project, cut and paste task activity, games, puppet shows and problem solving.

Learning Style and Teaching Style.

Students and teachers should have self knowledge regarding the process of learning and they have preferences of their own. When the teachers are aware of their way by which their personalities and learning styles affect the instructional process they can tailor the teaching process to cater the individual differences. If this is not happen in the actual classroom situation they often feel frustrated and cannot be able to accommodate with students (Felder, 1993). Studies show that most of the teachers teach in the way of how they learnt (Stitt-Gohdes, 2001) and how they learnt (Bailey et al, 1996). Teachers can help teachers by adjusting them to relay on learning strategic and to expand or stretch learning experiences.

A key stone in the theoretical foundation of any description on learning and teaching style is the acceptance that there is no single correct way to learn or to teach. Individual style influence how an individual learns, how individual teachers teach and how the two interact with each other (Babu & Gafoor, 2015). Various researchers examined the relationship between teaching style and students achievement in other learning outcomes (Evans, Harkins & Young 2008). The matter of mathing teaching and learning style is yet to gain required explanations; matching teaching style to learning style improves academic success in schools (Dasrai, 2006). When there is a match between learning style and teaching style the learners can enjoy and actively participate in learning activities (Slater, Lujan, & Di Carlo, 2007). Integrating sensory modalities or the preferred learning styles of the students not only act as a key factor in ensuring the effective delivery of teaching materials but also reinforce learning and focus on the retention of concepts.

Teachers are responsible for teaching as best they can and in a varied way. Students are responsible for their own learning. Regardless of the strategies that teachers use it is the responsibility of the students to "bend" the intake from the teacher into their own way of learning. It is of little use for a student who has a zero score for their Read/write preference to write longs lists of what has to be remembered or to spend hours reading and re-reading chapters or writing important definitions ten times.

Mind maps of these three learning modalities are illustrated in Figure 2.

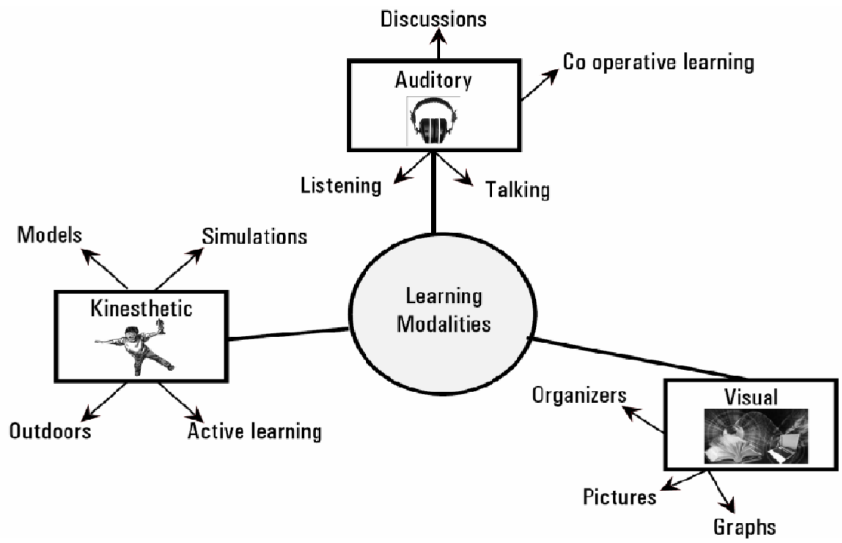


Figure 2. Mind Maps of Visual, Auditory and Kinaesthetic Learning Styles

Assessment of Learning Style.

Learning style is highly relevant in school and higher educational sector. This area demands coherent programmes to find out the implications on the actual outcomes of learning process. Learning style, cognitive style and personality are the constructs that can be used in the similar context with different measuring tools (Curry, 1983; Riding & Cheema, 1991). Cassidy and Eachus (2000) point to evidence that indicates that learning styles change in response to learning environments and that students report using different styles under different circumstances. Learning styles have been categorized from a variety of different perspectives and there are many types of assessments.

Learning Style measuring devices follows different psychometric considerations which are dealt in the above paragraphs and each measure has varying degree of reliability. Obviously it is very difficult to have stable measures; what is being measured is not always clear and when, in particular is not against behavioural outcomes. There appears to be a strange belief in the learning styles area that measuring these aspects of behaviour and then categorising people according to the types or traits is a non-controversial activity. On the one hand, users of learning styles measures say that the results reflect fundamental aspects of learner behaviour yet on the other hand they do not think that these 'fundamentals' might not have bad influences on wider behaviour if they are over-interpreted or misinterpreted.

Canfield Learning Styles Inventory.

It identifies learners with variety of learning styles but this inventory does not show any association with any outcome measures.

Felder-Solomon Inventory of Learning Styles (Felder & Silverman, 1988).

It has been used extensively in engineering and related areas and data has been presented at conferences but there is very little published in professional journals. A major critique of the FSILS was published by Markham (2000) where they came to the conclusion that there was little to support its use as a measure of learning styles. The FS-ILS has been used and found that the FS-ILS was extremely poorly defined, with factor structures having very little relationship to what they were supposed to be.

Honey and Mumford's Learning Styles Questionnaire (HM-LSQ).

Researchers in the field of education shows little support for using the HM-LSQ in education. It had no predictive validity against the performance of students in their course of study. That is, learning style did not relate to academic performance.

Kolb Learning Styles Inventory (Kolb, 1999).

It grew out of Kolb's work on independent learning and, in that sense, has a strong foundation. It determines the learning styles in a cyclic manner.

Perceptual Learning Style Preference Questionnaire (PLSPQ).

This questionnaire is used by Markham (2000) but only available from original author.

Vermunt Inventory of Learning Styles (VILS).

The VILS is a relatively unreported measure of learning styles, coming from Holland but being taken up in the UK. Vermunt (Boyle, Duffy & Dunleavy, 2003) has utilised constructivist thinking in conceptualising and developing the VILS. Boyle, Duffy & Dunleavy (2003) found that, for a UK sample, the VILS' factor structure held together but that the correlations of factors with academic performance did not follow the theory at all well.

Neil Fleming VARK Questionnaire (1992).

It is a Guide to Learning Styles and can be used by various researchers but available to the original author only. VARK is used to identify the different modes of preferences or the preferences that each of us taking and expressing our learning. This questionnaire is based on the theory of neuroscience and it explores how the learners process information inside our brain. The questionnaires contain questions related with observations of behaviours under concrete situations that respondents can recall or imagine and identify. VARK is more indicative rather than diagnostic in nature. It is focussed on only one of the element of a learning style although they prefer to use VARK a learning style instrument.

VARK is not, as it has nothing to record about a learner's preference for choosing to learn early in the morning or in large groups or by using mobile phones or about the other 20 or 30 elements that make up a learning style. Fleming and Mills (1992) said that it includes only four categories to reflect the experiences of their students and this device can be easily used and did not ask on lengthy questions like k-LSI that contain 44 questions, i.e. 11 for each of the four dimensions. It took only little time about five minutes to complete the response.

Theoretical Overview of Science Process Skills (Basic and Integrated Process Skills)

Science is a human endeavour which describes the physical as well as biological aspects of the human development. Science is derived from the Latin word scientia which means "to know". Science is mainly encountered with nature and composed of discoveries which demands curiosity, critical thinking and analysis. Achieving scientific discovery is the main goal of education according to 'National Research Council' (NRC, 1996) and 'American Association for Advancement of Science' (AAAS, 2000). In science, process aspect is more important than the product aspect so the curriculum should integrate the various processes (NCERT, 2003). Again UNESCO (1978) stated that the most important objective of science education in India, especially at the secondary level, was the understanding of the nature and applicability of various processes. Meta analysis of the different definitions in science also recommended that "Science is a process as well as product". The process aspect of science is a set of skills which are used by scientists for verifying or discovering theories. Whereas the product aspect includes the facts, theories, law and principles which are emerged as a result of the above discoveries.

Enger and Yager (2009) argued that learning of science is oriented around six major domains and their integrated development will yield scientifically literate citizen. Six domains comprises 1) The *Concept Domain*- includes facts, concepts, theories etc; 2) P*rocess Domain*- thirteen process Skills identified by American Association for Advancement of Science in 1968 known as scientific skills; 3) *Application Domain*- ability to apply scientific knowledge 4) *Attitude Domain*- Development of positive attitude towards science; 5) *Creativity Domain*- thought patterns representing divergence or convergence; and 6) *Nature of science*- why, what and who aspects of science. Science processes are certain skills and abilities like observation, measurement, communication, hypothesis formulation and changing variables etc. and these skills form the foundation for the origin of theories, generalisation, principles and theories. They are mental skills which require hands-on or minds-on experiments which will leads to process skill development and rich learning experiences (Rao, 2008). The process approach in science is more effective for improving the achievement in science and for developing positive attitude (Blosser & Mayer, 1983).

Origin of Science Process Skills.

The term Science Process Skills was recently originated and in earlier literature it is synonymous with scientific method, scientific thinking and critical thinking. During the first half of 1960's there was a boom in the science education programmes and the process aspect was the centre of discussion among educators. American Association for Advancement of Science in 1960 initiated a programme called 'Science a Process Approach' (SAPA) and emphasised the importance of process aspect of science. In addition to this lot of other curriculum projects namely 'Physical Science Study Curriculum' (PSSC), 'Harvard Physics Project' (HPP), 'Elementary Science Study' (ESS), 'Science Curriculum Improvement Study' (SCIS), 'Elementary School Science Curriculum Improvement Study' (ESSP), 'School Science Curriculum Project' (SSCP), 'Chemical Education Material Study' (CHEMSTUDY), 'Chemical Bond Approach' (CBA), 'Science in Process', 'Warwick Process Science' (WPS), 'Nuffield Courses' in the UK also highlight their significance. By realising the need and importance of Science Process Skills, Current Science Education Standards such as Science for All Americans (SAA, 1990), the Benchmarks for Scientific Literacy (1993), National Research Council (NRC, 1996), and National Science Teachers

Association (NSTA, 2002) proposed the inculcation of Science Process Skills among the school students. National curriculum Framework (NCF, 2005) recommended that the most important objective of teaching science in secondary level will be the growth of these skills.

Definition of Science Process Skills.

Science Process Skills are the methods or activities which are undergone by students for the execution of scientific discoveries which empower students with knowledge and skills. Opera (2011) argued that "Science Process Skills help students to give descriptions, raise questions, construct explanations, and test their findings against the current theories and to communicate the developed ideas with others". Millar and Driver (1987) defined Science Process Skills as "those process of inquiry that form basis to all scientific disciplines. It encompasses various processes used by scientists for investigating the natural world; the cognitive processes involved in learning science and pedagogical processes taking place in classroom".

Science Process Skills can be defined as "the skills which help to learn, provide to gain the discovering and researching ways and methods, increase the permanence of the learning, make the students active, improve the responsibilities of the students, and help them to understand the practical studies, improve the sense of taking responsibility on their own learning (Aktamis & Ergin, 2008). Karsli, Sahin and Ayas (2009) defined these skills as the "adaptation of various skills used by scientists for developing, thinking about problems and formulating conclusions". Researchers have variety of opinion regarding, how many Science Process Skills they identified and classified into the basic and advanced groups. Most researchers agree the basic Science Process Skills are observing, inferring, predicting, classifying, measuring, and communicating (Ozgelen, 2012).

According to Brotherton and Preece (1996), the basic Science Process Skills helps in providing the intellectual groundwork for scientific inquiry such as ability to order and describe natural objects and events. During the development of integrated process skills the learners can integrate the basic process skills and they are able to design the tools to investigate the phenomenon under study (Rambuda & Fraser, 2004). In addition, Science Process Skills help students to make citizens more responsible in their own learning process, more permanent learning and make expert in research methods (Karamustafaoglu, 2011). Science Process Skills are essential for students because they need to know how to question and how to determine the relationship between two variables or discover and explain a phenomenon.

Classification of Science Process Skills.

Science Process Skills are classified in to two major group namely *Basic Process Skills* (BPS) and *Integrated Process Skills* (IPS) (AAAS, 1968; UNESCO, 1992). In this, basic process skills are the lowest skills or the foundation skills, which helps to acquire higher level skills i.e. integrated process skills. BSPS includes skills of Observation, Communication, Classification, Measurement, Prediction and Inference. ISPS includes controlling variables, Formulation and Testing of hypotheses, Collection and interpretation of Data, Experimentation, and Making Operational definitions. Even though these process skills are unique they are mutually dependent. There is no specific order or sequence, but most of the time starts with observation and others come later.

Basic Process Skills.

Science contributes unique skills which are the pervasive goal of science education and appropriate to many other disciplines also. The curriculum project SAPA grouped science process skills in to basic skills and integrated skills. Basic skills provide foundation for learning the more complex or integrated skills. Important Basic Process Skills are;

Observing.

It is the fundamental skill and it includes gathering of information about an object or an event by using sense organs. More accurate information can be provided through deep observations. The observation can be qualitative and quantitative. Qualitative observations are qualitative in nature that is descriptive terms such as colour, smell, texture, properties and characteristics' of object or things or organisms. Quantitative observation refers to notice the numbers in terms of object or things or organisms. Quantitative observations usually are more precise than qualitative observations.

Classifying.

Classification is the process of sorting, grouping, ordering or arranging objects on the basis of similarities and differences, larger or smaller and other common characteristics. Classification is also done in qualitative and quantitative manner. Classifications based on qualitative properties like size, shape, colour, habit and the nature of substances such as smoothness, roughness, hardness and softness similarly characteristics like opaqueness and transparent etc. Quantitative classification is based on number. For example classification based on age, number of leaf or petals in a flower etc. The classification can be binary or multistage. In binary classification system a set of objects or things are classified into two subsets. In multi-stage classification each subsets follows consecutive binary classification or succession of binary classification.

Communicating.

It refers to conveying of information from one person to another by means of verbal or nonverbal methods. In Verbal communication the information are orally conveyed using clear scientific terminologies. Nonverbal forms of communication are by using nonverbal methods like using charts, graphs, maps, and drawings, symbols, pie chart, tables, chemical formulas of particular element or compound, symbols of electric component, and flow chart for communication.

Measuring.

It is the act of using numbers to describe objects or events. In this process, measure the attributes such as temperature, length, breadth, height, area, mass, and volume by using standard measurement processes. It involves calculation and representing the answer in referred units. Selection of appropriate unit and familiarity with its usage is very crucial for good measurements.

Prediction.

Predictions are the statements about what might happen or could be expected to happen in the future. Prediction is the act of meaningful guessing the forecasting events based on a previously developed model or experience or based upon the previous knowledge. A person to be more confident in making predictions related to a situation when they are acquainted with a most suitable model. Unlike inferences, predictions are verifiable. Predictions are kinds of thinking that require learners' best guesses based on the information available to them. It helps the learners to predict what will happen if something is changed in a situation. Prediction can develop one's deep thinking and logical analysis and interpretation. Before conducting an experiment or activity one can predict 'what will happen? Later, prediction should be verified. Prediction also can be based on inferences.

Inference.

Inference is the act of making statements based on observations. Inference is a process of making suggestions, conclusions, assumptions or explanations about a specific event based on observation. Inferences and observations are not equal, but observations are the base of any inference.

More than single inferences can be made on the basis of different observations. Observation is the use of one's sense organs to perceive objects and events and their properties, where as inferences are making statements or conclusions after a deep observation and understanding of a phenomenon. This skill helps to identify the cause- effect relationship between the variables.

Integrated Process Skills.

Integrated process skills are the higher level skills like;

Formulating hypotheses.

Hypotheses are the tentative statements or expected outcome of experiment or a process, which are testable. It is not mere guesses rather a creative or intrinsic mental process that needs experiences. Sometimes the hypotheses may be rejected based on the observed facts and events.

Controlling variables.

This skill composed of the identification and manipulation of variables that affect an experiment. During the experimentation some variables are kept constant and the effect will be observed by the manipulation of others. In this students are able to identify the cause-effect relationship between the variables of an experimental process. The variable which is manipulating is called independent variable and the variable on which the effect is measured is known as dependent variables.

Making operational definitions.

In this, variables are operationally defined on the basis of measurable and observable terms. An operational definition should not posses explanation and interpretation about the meaning of the variable, rather it is explicitly defined to the parameters established for giving definition. Generally it acts as a research tool and associated with the manipulation of variables. The major function of operational definitions is to establish the parameters of an investigation or conclusion in an attempt to gain a higher degree of objectivity.

Collection and Interpretation of Data.

In this skill the learners collect qualitative and quantitative data by means of observation, measurement etc. which are needed for experimentation. After this collection, children learn to reason from data and perform numerical analysis to reach meaningful conclusions. For recording data they may use tables, charts, graphs etc. for easy visualisation and further use.

Experimenting.

This process is a systematic approach to study and solve a particular problem. In experimentation process each step emerges and followed by the previous one. The objective of the process is to judge the extent to which a hypothesis might be true and to set a standard whereby that judgment is made. Consequently, scientists tend to think in terms of probabilities of truth rather than absolute correctness. Absolute proficiency and complete independence with experimental methodology are not expected in elementary grade but increasing sophistication is sought in each of the underlying process: observing undertaking hypotheses, identifying variables, staring operational definitions, controlling variables, drawing inferences and organizing data, intercepting data, formulating 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 and
13. Experimenting

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

i) Recognizing and defining a problem

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

ii) Formulating the hypotheses

The test items in these sections contain the tentative solution to the problem. By analyzing the data the students select the best inference that can be drawn from the given evidences.

iii) Collecting data

This category focused on the behaviour of science student involving in enquiry. The designing of procedure for performing experimental task, 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/qualitative judgments.

v) Evaluating hypothesis

The students need to check whether or not the finding verified the hypothesis. Therefore in this sub test the student is computed to find out whether the evidence in consistent with the formulated hypotheses.

vi) Formulating generalization

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

Importance of Science Process Skills.

Process skills are the important domain of science and which act as the foundation for all other developing domains of science. The nature of process skills includes the systematic method of knowing scientific concept. It includes the following aims in science education.

- To improve Process skills which are directed to the development of scientific concepts.
- To make the ability to have productive thinking which are encountered by the creation, innovation and discovery of useful objects.
- To verify the existing postulates in science and generate new concepts based on inquiry process.
- Identify and establish the relation between cause and effect variables in the process of experimentation.
- To inculcate values in science such as scientific attitude, scientific appreciation and scientific temper through Science Process Skills.
- Away from superstations beliefs and accommodation of scientific theories and principles in daily life
- To associate physical and biological world around the individual to have integrated sustained growth.

Development of process skills in secondary school stage is crucial because observation, ability to use symbols, verbal and nonverbal communication and higher cognitive activities like problem solving, creative and critical thinking are the skills used by the children at this stage. At the elementary stages, children's process skills are limited and unsystematic; teachers of science need to give adequate inputs about process skills at very early stage so that when they grow, pupils use these skills proficiently. If process skills are not developed among the students of secondary stage, then the teacher cannot expect them to develop higher order skills in their later stage. Therefore, this is the crucial stage for developing Science Process Skills. By using science process skills, students can be able to test their old and new ideas, to construct meaningful relationships between facts and ideas (Harlen, 1999). Science Process Skills can help teach science content because students are more motivated to learn and students are learning the answers to their questions. Students take ownership of their experiment and they will more likely to remember the information (Harlen, 1999).

Assessment of Science Process Skills.

Science has a key role to play in developing skills of critical thinking, problem-solving and the ability to use and evaluate evidence. The development and achievement of these important outcomes has to be included in the assessment of learning in science. It is important to assess process skills only in relation to content where the conceptual understanding will not be an obstacle to use process skills. Andrew (1980) developed a test to evaluate skills in scientific process of secondary school pupils using Klopfers' classifications. The item cover Physics, Chemistry and Biology. Burnis, 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.

Another method for assessment of Science Process Skills is use of formative assessment methods. Data required for formative assessment can be gathered through observing students how they execute their works, by questioning and asking students to communicate their ides through drawings, artefacts, actions, role play and concept mapping methods (Harlen, 1999). Several tools are found to be used for assessing these skills developed and standardised by different authors. Some of them are briefly described as follows.

Science Process Skills Test (SPST).

This test had been developed by Enger Ve Yagar (1998). This instrument comprised of 36 items, measures 5 process skills: (i) identifying variables (12 items), (ii) operationally defining (6 items), (iii) hypothesising (9 items), (iv) experimenting (3 items), and (v) evaluating data and graph (6 items).

Test of Integrated Science Process (TISP).

Burns, Okey, & Wise (1985) developed the Test of Integrated Science Process (TISP) which consisted of 30 multiple choice items and used to determine science process skills of students in middle and higher levels. The Cronbach alpha reliability coefficient of this instrument is 0.85.

Science Process Skills Assessment Test (SPSAT).

Developed by Temiz (2007) is a question pool consisting of multiple format items developed for measuring 1st year high school students' skills in the areas of variable identification, formulating hypotheses, variables modification and control, data recording (table formation), graphical representation and graph interpretation skills. SPSAT comprises six modules in total. Module- 1: 60 multiple choice questions to measure variable identification and formulating hypotheses skills, Module- 2: 30 questions (5 open ended, 25 multiple choice) to measure controlling and manipulating variable (designing an experiment) skills, Module- 3: 8 open ended questions to measure constructing data table skills, Module- 4: 8 open ended questions to measure graphical representation skills, Module- 5: 55 multiple choice questions to measure graph interpretation skills, and Module-6: 10 open ended questions to measure identifying variables and formulating hypotheses skills.

Review of Related Studies

Enormous numbers of related researches were identified by the investigator concerning the selected variables under study. All the variables under the study were highly relevant in the current scenario of education and practice. Hence the investigator reviewed only the recent studies related to all the three Predictor Variables and the Criterion Variables Process Skills in Chemistry.

Studies on Metacognitive Awareness

In this section studies related with Metacognitive Awareness are presented in the chronological order.

Kallio, Virta, Kallio, Virta, Hjardemaal and Sandven (2017) explored the utility of the compressed version of the Metacognitive Awareness

Inventory for Teachers (MAIT-18) among in-service teachers. Teachers' knowledge about the awareness of metacognition is required to support students' self-regulation, with the aim of establishing modern learning methods and life-long learning. The participants in this study were teachers (N=208) from different sectors of vocational education. The statistical techniques employed are the structural equation modelling and Confirmatory Factor Analysis for explaining good/acceptable model fit and convergence of each factor. The result of the study shows that MAIT-18 is useful in measuring the Metacognitive Awareness of in-service teachers and utility of the inventory has been examined among in-service teachers, comparative studies between in-service teachers and teacher trainees.

Pahayahay and Cisneros-Pahayahay (2017) find out the level of Metacognitive Awareness and its influence on performance in Mathematics. The sample selected for the study was college students and topic was Algebra. The study followed descriptive correlation research design. Results revealed that there is no significant difference between the students' level of metacognitive awareness by male and female respondents. Likewise, it was found that there is no significant relationship between the students' level of metacognitive awareness and their GPA. Moreover, the study indicates that there is a very weak negative relationship between the mathematics performance of the respondents and the level of metacognitive awareness and the results of the stepwise analysis show that Evaluation Strategy is a predictor of student's mathematics performance in college algebra. Findings also showed that the most dominant metacognitive strategies employed by the respondents in solving problems are conditional knowledge and debugging strategy.

Wolfe and Williams (2017) conducted a study on Metacognitive Awareness about students' belief change. The study followed an experiment design for examining the beliefs about spanking as an effective means of discipline. In two experiments, subjects reported beliefs about spanking effectiveness during a pre-screening session. An experimental session was followed subsequently and the subjects read a one-sided text that advocated a belief consistent or inconsistent position on the topic. The findings of the study indicated that after reading, subjects reported their current beliefs and attempted to recollect their initial beliefs. Furthermore, the relationship between the belief consistency of the text read and accuracy of belief recollections was mediated by belief change.

Baltaci, Yildiz and Ozcakir (2016) examined the relationship between Metacognitive Differences, Learning Styles, genders and Mathematics grades of the fifth grade students. it is a descriptive study and conducted by using relational screening model. The sample of the study consists of 330 fifth grade students from public middle schools. The instruments used in the study were Metacognitive Awareness Scale for Children" and "Learning Styles Scale". The findings of the study indicate that the relationship between Learning Styles and gender is not statistically significant. But, there is statistically significant relationship between Learning Styles and mathematics grades, Metacognitive Awareness levels and grade levels in Mathematics, MAL-gender and MAL-Learning Styles.

Jaleel and Premachandran (2016) assessed the Metacognitive Awareness Of Secondary School Students and significant difference based on gender, locale and type of management. The sample of the study consists of 180 secondary students drawn from different schools of Kottayam district of Kerala. The tool used foe data collection was adapted version of a five point scale Metacognitive Awareness Inventory. The methodology adopted is normative survey method. Results of the study indicated that secondary school students are different in their Metacognitive Awareness level and they are not significantly differing on the basis of locale, gender and type of management of the school.

Dagal and Bayindir (2016) investigated the relationship between the level of Metacognitive Awareness, self-directed learning readiness and academic achievement of preschool teacher candidates. The study followed a survey method, including 151 teacher candidates as sample from Ataturk Education Faculty, Preschool Teaching Department at Marmara University, Istanbul, Turkey. The instruments used for collecting data were Metacognitive Awareness Inventory (MAI) and The Self-Directed Learning Readiness Scale (SDLRS). The academic achievement was determined by taking the grade point average of teacher candidates. The results indicated that there was no significant relationship between the level of Metacognitive Awareness and self-directed learning readiness with academic achievement of teacher candidates but a moderate relationship between the total scores of the Metacognitive Awareness and self-directed learning readiness was found.

Oza (2016) investigated the role that Metacognitive Awareness in the enhancement of academic motivation among prospective English teachers in a Turkish context. The participants of the study comprised of 104 students and the Data were collected using the Metacognitive Awareness Inventory (Schraw & Dennison, 1994) and the Academic Motivation Scale. Findings revealed that relationship between metacognitive awareness and academic motivation is statistically significant. The analysis of moment structures and multiple squared correlations revealed that knowledge of cognition and regulation of cognition as the two major components of Metacognitive Awareness appeared as significant predictors of academic motivation, explaining 44% of the variance in the academic motivation of prospective English teachers.

Ozenc and Dikici (2016) identified the relationship between functional literacy level and Metacognitive Awareness of the fourth grade primary school students. The sample of the study consists of 406 fourth grade students attending school during 2015-2016 academic year in Nigde. The study also indented to check Metacognitive Awareness differentiates according to their gender, preschool education and their mother's employment status. This study adopts survey model and its data collection tools include the Functional Literacy Experience Scale based upon Ecological Theory (FLESBUET) and the Metacognitive Awareness Scale for Children. Findings of the study revealed a moderate positive and significant correlation between the level of functional literacy and Metacognitive Awareness of the 4th grade primary school students. Students' functional literacy level and Metacognitive Awareness level differentiate with respect of preschool education and mothers' employment. But there is no differentiation according to their gender.

Abdellah (2015) examined Metacognitive Awareness in relation to academic achievement and teaching performance of pre-service female teachers of Ajman University in United Arab of Emirates. The study was conducted on a sample of seventy five Female Students in Ajman University in UAE preservice Professional Diploma. The study follows a survey design and the instrument used were metacognitive Awareness inventory (MAI) and a checklist used to assess teaching Performance. Findings of the study assert the importance of metacognition in learning and the study recommended that college professor must adopt teaching techniques and strategies while transacting the content to students in a way that which will encourage use of Metacognitive Skills, which has an effective impact on academic achievement and teaching performance.

Farahian (2015) conducted a study to identify the relationship between Metacognitive Awareness and achievement in English as a foreign language (EFL).through this study the author made an attempt to construct and validate a Metacognitive Awareness writing questionnaire (MAWQ) since there is no report of a validated domain specific measure of Metacognitive Awareness of foreign language (FL).The questionnaire was developed by conducting interview with 59 EFL learners. Content analysis and related studies were used as a framework for Metacognitive Awareness and for validating the questionnaire, exploratory factor analyses was used.

However, in the analysis of the whole questionnaire through EFA, the researcher's assumption regarding the two general scales of MAWQ was supported indicating that knowledge and regulation of cognition are two main components of MAWQ.

Sawhney and Bansal (2015) studied the relationship between Metacognitive Awareness and academic achievement of undergraduate students. Sample of the study consist of 100 undergraduate students taken from different colleges of Chandigarh. Required data were collected by using Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1994). The findings of the study indicated that there is significant difference was found in academic achievement with respect to high and low scores in Metacognitive Awareness.

Karimi and Dowlatabadi (2014) investigated the influence of authentic materials on Metacognitive Awareness and listening comprehension. This study followed quasi-experimental design with an experimental and a control group. The sample of the study comprises 50 Iranian EFL students of university in Iran. Equal number of subjects was present in experimental and control group. Instruments used for the study was listening proficiency test to know the level listening comprehension, Metacognitive Awareness questionnaire (MALQ) to determine Metacognitive Awareness and perceived use of listening strategies. Findings of the study noticed that three strategies namely direct attention, persons knowledge and problem solving strategies are used. Among the different strategies direct attention was often used by EFL learners and listening comprehension was enhanced with use of authentic materials in EFL classroom.

Kirbulut (2014) investigated the relationship between chemistry self efficacy and Metacognitive Awareness of high school students through a path model analysis. The study comprises 268 high school students who are studying chemistry both in 10^{th} and 11^{th} grades. Instruments used for measuring the variables was High School Chemistry Self Efficacy Scale developed by Capa, Aydin and Uzuntiryaki(2009) and junior Metacognitive Awareness Inventory developed by Sperling et al (2002) and adapted to Turkish version by Aydin and Ubuz (2010) was used. The findings of the study revealed that self efficacy and Metacognitive Awareness are significantly related. Also students with high self efficacy are found to be more aware of knowledge and regulation of their cognitive abilities and processes.

Jayapraba (2013) examined the effect of Metacognitive and co-operative instructional strategies on achievement in science. The study followed a quasi-experimental design with three groups namely two experimental groups (one co-operative learning group and metacognitive instruction group) and a control group. Instruments used for the study was Metacognitive Awareness inventory developed by Schraw and Dennison (1994) and achievement test science especially in anatomy. Statistical techniques used for the study was paired t-test and multiple regression analysis. Results of analysis revealed that metacognitive instructional strategy was more effective than other two instructional strategies for enhancing academic achievement. Also the study showed that there is significant relationship between Metacognitive Awareness and achievement.

Narang and Saini (2013) carried out a study to know the impact of Metacognition on academic performance of rural adolescents. The sample of the study consisted of 240 rural adolescents studying in 7th, 8th, 9th and 10th grades and equal number of subjects were selected from each grades. The results were compared on the basis of gender and socio- economic levels. Metacognitive skills were assessed with a self structured questionnaire which is adapted from metacognitive inventory and Metacognitive Awareness Inventory. Academic performance was taken aggregate of marks obtained in the last examination. Results from analysis indicated that majority of students scored high in Metacognitive Awareness and secured high academic performance also the knowledge and regulation dimension of metacognition significantly contributed to performance of rural adolescents.

Kilinc (2013) investigated the relationship between self esteem and Metacognitive Awareness. The study also analysed whether there exist any significant difference in self esteem and Metacognitive Awareness according to gender and school type. The sample of the study consists of 211 students studying in 9th grade from one private school and one public school was used. The data needed for the study was acquired through Rosenberg self esteem scale (1965) and Metacognitive Awareness scale (Sperling et al, 2002). The t test and Pearson's product moment coefficient of correlation are the major statistical techniques used for analysing the data. Results of the study indicated that there is an average relationship was found between self esteem and Metacognitive Awareness of students. In the case of subsamples no significant difference found in self esteem on the basis of gender and type of school, whereas for the Metacognitive Awareness female students and public school students are having higher metacognitive awareness.

Bedel (2012) explored the level of locus of control, epistemological belief and Metacognitive Awareness and identified the relationship between these variables. The study was conducted on a sample of 206 preservice early childhood teachers studying in the University of Turkey. Of the participants 187 were females and 19 were males. The data were acquired with instruments: Rotters' internal- external locus of control scale (1966), central epistemological scale developed by oksal, Sensekerci and Bilgin (2006) and Metacognitive Awareness scale developed by Shraw and Sperling-Dennison (1994). Product moment coefficient of correlation and multiple regression analysis are the major statistical analysis carried out in the study. Findings of the study revealed that there exist significant positive correlation between locus of control and two factors of central epistemological belief scale and between Metacognitive Awareness and last two factors central epistemological belief scale. In addition to this, the study identified that first two factors of epistemological scale was the significant predictor locus of control.

Chantharanuwong, Thatthong, Yuenyong and Thomas (2012) explored the Metacognitive Orientation of students in the science classroom. Data was collected form a sample of 1,367 students of grades 10-12 taken from 10 different provinces of Thailand. The instrument used for data collection was Metacognitive Orientation Learning Environment Scale-Science (MOLES-S). This instrument consists of 35 statements representing seven dimensions of metacognitive orientation. The findings mean analysis revealed that all represented students are sufficiently metacognitively oriented in science classroom except in dimensions student voice and distributed control. Findings from one-way ANOVA indicated that there is no significant difference in Metacognitive Orientation with respect to gender, school, grade and age.

Kazemi (2012) compared the difference in Metacognitive Awareness in Mathematical problem solving by using mixed method. The methods used were protocol analysis and self questionnaire methods. 64 university students (34 boys and 30 girls) were participated in the study. In this study students were asked to write down about their mental process during solving a non - routine mathematical problem and these writings were analyzed by Foongs model. Immediately after this, participants were asked to complete a valid, reliable instrument in Metacognitive Awareness. It is cleared from the result that the two methods show a significant moderate correlation in the measurement of Metacognitive Awareness. So from the study it is concluded that measurement of Metacognitive Awareness is not fallible, rather it provides a stable measurement of metacognition.

Ozgelen (2012) explored the relationship among Epistemological belief, Metacognitive Awareness and nature of science. This study followed a mixed method design in which the qualitative and quantitative data were collected at same time. The sample of the study consist of 45 pre-service science teachers enrolled in two sections of laboratory application in science 11 course in Turkey university. At the initial survey phase the researcher collected data to explore preservice teachers' ideas about nature of science. During intervention stage the impact of Explicit- reflective and inquiry – based laboratory instructions were studied. The data were acquired through the instruments The Views of Nature of Science Questionnaire Version B (VNOS-B) developed by Lederman, Abd-El-Khalick, Bell, and Schwartz (2002). The re-searchers revised some items of the VNOS-A (Lederman and O'Maley, 1990) to assess pre-service science teachers' views of the NOS. Epistemological belief questionnaire developed by Hofer (1997), Metacognitive Awareness inventory developed by Schraw and Dennison (1994). These tools are applied before and after the intervention. Results of the study revealed that preservice teachers had improved in some aspects of nature of science. The epistemological belief and Metacognitive Awareness are significantly improved through inquiry based instruction.

Yuksel and Yuksel (2012) examined the Metacognitive Awareness of reading strategies and identified what are the strategies they are normally used while reading academic materials. The study was carried out on a representative sample of 16 students studying English as a foreign language enrolled in Anadolu University in Turkey. Tool used for collecting the data was Survey of Reading Strategies (SORS), developed by Mokhtari and Sheorey (2002) was used. Through the survey the researcher identified three major reading strategies namely Global, Problem solving and support reading strategies. Result of the study revealed that Turkish EFL students are often awared about academic reading strategies but they are using it. In addition to this they prefer problem solving strategies to overcome reading difficulties and support strategies are leastly used by them in academic reading.

Ciascai and Lavinia, (2011) identified the gender differences in Metacognitive skills. It is a survey study with a sample of 91 eighth standard students studying in Romania. The instrument used for assessing metacognitive skills was Junior Metacognitive Awareness inventory. Result of the study indicated that boys and girls in the schools Romania used their metacognitive skills in learning but there exist a significant difference in some aspect regarding the knowledge and regulation of metacognition.

Jordan (2011) explored the teacher practices and examined whether it is enhancing the metacognitive skilfulness of high school chemistry students. This study used a mixed method design contain both qualitative and quantitative analysis. Metacognitive skilfulness are measured using pre and post metacognitive activities inventory and students actual metacognitive abilities are measured at the end of the study using Interactive Multimedia Exercises (IMMEX), an internet software system developed by Cooper Research group in 2007. Teacher practices are studied using documents, artifacts, observation notes, lesson plans and lab related assignments. The study identified that teacher practices includes(a) question-answer method (b) usual stepwise calculation of problems (c) absence of probing questions in all stages of instruction (d) absence of critical design. From the findings the study revealed that students have an intermediate level of metacognitive skilfulness and the existing teacher practices do not encourages metacognitive skills rather they are making learners passive and task oriented.

Kesici, Eedogan and Ozteke (2011) determined the association between Metacognitive Awareness and achievement in Mathematics and Geometry of high school students. Qualitative method was used in the study. The study was conducted on a sample of total 213 students (108 males and 105 females) studying in 10th and 11th levels. Required data was collected by using the instrument Metacognitive Awareness inventory by Schraw and Dennison (1994) and it has been adapted to Turkish version by Akin, Abaci and Cetin (2007). Mathematics and Geometry achievement were obtained as GPA's from school records. Data were statistically analysed by using stepwise multiple regression analysis. The findings of the study showed that declarative knowledge is a significant predictor in mathematics achievement and evaluation and procedural knowledge are the significant predictors of geometry achievement.

Rahman (2011) studied the impact of Metacognitive Awareness of science teachers and students on the performance of students in the subject of Chemistry. Population of the study include science teachers and students, representative sample was randomly selected by multistage sampling technique. The size of the sample in the study was 120 science teachers and 1800 secondary school students. Metacognitive Awareness of students and teachers were separately measured by using Metacognitive Awareness

Inventory by Schraw and Dennison, 1994. Performance of students in the subject of chemistry was assessed with the help of researcher made multiple choice test in chemistry. Both parametric and non parametric techniques are used in the analysis. Results of the study are (1) male science teachers dominated over female science teachers in total and component wise score of metacognitive awareness (2) teachers who are having more than 15 years of teaching experience, attended in service courses, high academic qualifications scored high in metacognitive awareness (3) there is no significant difference in Metacognitive Awareness of students with regard to gender (4) students who got opportunity for tuition and high parental education level improved over others in Metacognitive Awareness and achievement in Chemistry (5) Students who are taught by highly metacognitively awared teachers perform better in MAI test and achievement test. Furthermore the study identified certain skills which are helpful for present and future teachers who are intended to become ideal.

Shokrpour, Zareii, Zahedi and Rafbaksh (2011) determined the impact of cognitive and metacognitive strategies on test anxiety and educational performance. It was an experimental study with three groups, i.e. two experimental groups and one control group. Participants of the study include total of 84 students who are selected randomly and subjected to treatment. Cognitive strategies were applied in one group and metacognitive strategies were applied to other experimental group. The instruments of the study included questionnaire on anxiety (Abolghasemi & Najarian) and educational performance was assessed by taking GPA score already obtained in first and second terms. Pre test scores of both groups are taken and score in the first semester before experimentation and post test scores and second semester scores are taken after experimentation. Comparison of scores using t-test indicated that there exist significant difference in difference in pre test and post test scores of experimental and control groups. Further there is no significant difference between two experimental groups. So it can be concluded that the attributed difference in test scores in anxiety and educational performance was the impact of strategies.

Rahman, Jumani, Chaudry and Abbasi (2010) assessed the Metacognitive Awareness and studied its impact on students' performance in the subject of Chemistry. Sample of the study consist of 900 students studying at grade x, are selected through random sampling technique. Metacognitive Awareness was measured by using Metacognitive Awareness inventory (Schraw and Dennison, 1994) and performance in Chemistry was determined by researcher made Achievement Test in Chemistry. Results indicated that Metacognitive Awareness and achievement are positively correlated and students with high Metacognitive Awareness are found to performing better than students with lower metacognitive awareness. In addition to this male students gained higher mean score than female students both in test and Metacognitive Awareness inventory.

Temur, Kargin, Bayar and Bayar (2010) identified the difference in Metacognitive Awareness among 6th, 7th and 8th grade students in reading strategies. The study was conducted on a total sample of 101 with 31 from grade six, 36 from grade seven and 34 from grade eight were randomly selected. Metacognitive Awareness Reading Strategies Inventory (MARSI) developed by Mokhtari and Reichard (2002) was used to assess Metacognitive Awareness and perceived use of reading strategies between the selected grades. Analysis of data using ANOVA indicted that there is no significant difference between 6^{th}, 7^{th} and 8^{th} grade students' metacognitive strategies awareness in global, problem solving and support reading strategies.

Wilson and Bai (2010) determined the pedagogical understanding and knowledge about metacognition and studied the relationship between them. The study utilized mixed methodology with qualitative and quantitative aspects. The participants of the study were 105 graduate students. Results of data analysis revealed that metacognitive knowledge of participants had significant impact upon pedagogical understanding. Also teachers with good metacognitive understanding need to have students with complex understanding about metacognition and thinking strategies.

Memnun and Akkaya (2009) examined the level of Metacognitive Awareness among primary teacher trainees and checked their differences in Metacognitive Awareness according to gender and class level. The sample of the study consist of 263 teacher trainees out of this 157 are female and 106 are the male trainees studying in various Turkish universities. The tool used for the collection of data was Inventory of Metacognitive Awareness by Schraw and Dennison (1994) and which is adapted to Turkish version by Akin, Abaci and Cetin (2007) was used. The collected data was statistically analysed by using independent sample t-test and one way ANOVA.

Findings of the study revealed that majority of teacher trainees shows a higher level of Metacognitive Awareness and there is no significant difference exists in Metacognitive Awareness of teacher trainees according to gender, but according to class level there appeared a significant difference.

Ibe (2009) investigated the effects of metacognitive strategies on classroom participation and achievement in science among senior secondary science students. The study used a quasi-experimental design with three intact groups namely two experimental, one with Think-Pair-Share strategy (TPS) and Metacognitive Questions (MQ) strategy and a control group. Sample of the study was senior secondary school students with number of subjects 24, 22 and 21 for control, TPS and MQ respectively. Achievement was measured with help of achievement test developed by the investigator and it is in the topic density. Data were statistically analysed with mean, standard deviation and ANCOVA. Findings indicated that metacognitive Instructional strategies are more effective for improving academic achievement followed by TPS. So the researcher recommended that TPS and MQ help learners to learn materials more efficiently and maintain information for longer time.

Saribas and Baryam (2009) created a self regulated, motivated Chemistry lab environment for improving Science Process Skills and attitude towards Chemistry. The study followed an experimental design with two group pre-post test design. The sample of the study consist of 54 preservice science teachers attending the lab course in Chemistry are selected. Instruments used for the study includes Science Process Skill Test (SPST) developed by burns, Okey and Wise (1985) for measuring five the process skills identifying variables, stating hypotheses, making operational definitions, designing investigation and graphing and interpreting data. Attitude towards Chemistry was measured by using Attitude Towards Chemistry Scale (ATCS) designed by Lu (1993) and motivated strategies for Learning Questionnaire (MSLQ) is a self-report instrument designed by Pintrich, Smith, Garcia and Mc Keachie (1991) to understand students' motivational and self efficacy beliefs. Results of the study showed that the performance of experimental group was higher than that of control group in the process skill category of controlling the variable and operationally defining variables.

Ozsoy, Memis and Temur, (2009) investigated the relationship between Metacognition, study habits and study attitudes. The participants of the study were 221 primary school students, out of this 125 are female students and 96 are male students studying in six different primary schools of Turkey. Metacognitive knowledge and skills were assessed by a multimethod inventory named Metacognitive Knowledge and skills Assessment developed by Desoet, Roeyers and Buyrse (2001) and adapted to Turkish by Orson (2007). Study habits and attitude are assessed by using Survey of Study Habits and Altitudes (SSHA) developed by Brown and Holtzman (1965). The results revealed that there is a moderate relationship between metacognitive knowledge, study habits and attitudes. Further there is a significant relationship for high achievers and no relationship for low achievers.

Young and Fry (2008) explored various dimensions of Metacognitive Awareness Inventory (Schraw and Dennison, 1994) and identified how these are related to broad and single measure of achievement. The sample of the study includes 178 college students belonging to graduate and under graduate levels. The data was analysed through correlation technique and the results revealed a strong correlation between MAI and broad measure of academic achievement. For the scores on MAI, graduate and under graduate students differ significantly in knowledge of cognition and regulation of cognition. Furthermore the study suggested that MAI can be used as a screening tool for college level teachers for improving academic achievement by means of metacognitive interventions.

Guterman (2003) conducted a study to improve the academic performance of students through Metacognitive Awareness Guidance (MCAG). The study followed an experimental design with a control group, placebo group and treatment group. A total of 300 pupils studying in fourth grade of four different schools in Israel were participated in the study. Performance of students was measured in three achievement tasks viz, achievement on reading assessment task, performance on Metacognitive Awareness guidance and awareness of metacognitive reading strategies. Analysis of results shows that the treatment group attained significantly higher scores than other two groups. So the study suggested that MCAG is a critical tool for improving the performance of students.

Sheorey and Mokhtari (2001) studied the difference between native and non native English speakers Metacognitive Awareness in reading strategies while engaging in academic reading task. The participants of the study included a total of 302 college students (150 US and 152 ESL students) who are required to complete a survey on reading strategies used by them while approaching reading tasks. Findings of the study indicated that both US and ESL students are awared about reading strategies mentioned in the survey and they are categorized the reading strategies based on their competence as (1) Support reading strategies (2) metacognitive strategies and (3) cognitive strategies. Higher reading ability students in both groups are frequently used cognitive and metacognitive strategies than lower reading ability students. Also higher reading ability students in both groups are reported that support strategies are more valuable than other two strategies. Furthermore female students of native readers reported higher frequency of strategy use than non native readers of America.

Studies on Goal Orientation

In this section studies related with Goal Orientation are presented in the chronological order.

Ben-Eliyahu, Linnenbrink-Garcia and Putallaz (2017) investigated the relations of academic and social Goal Orientations to academic and social behaviours and self-concept among academically talented adolescents attending a mastery-oriented academic residential summer program. Results revealed that mastery goal orientations predicted academic abilities; class engagement, scholastic self-concept and general outcomes like global self-worth self-concept more than any other goal orientation. The study also identified that academic mastery goal orientations predicted course performance and responsible classroom behaviour only for girls and academic mastery goal orientations were positively related to close friendship self-concept for boys. Furthermore the social development goal orientations were uniquely associated with social self-concept for girls and there were some unique patterns regarding social demonstration-avoidance goal orientations for boys.

Guler (2017) studied the influence of Goal Orientation on achievement of students. The study followed a meta-analytic pattern with studies of 426; out of 106 studies are compiled to obtain holistic nature. The findings of the study revealed that Goal Orientation construct had a low-level positive influence on achievement of students. The study also identified that educational level, subject and the cultural differences the main moderators of Goal Orientation.

Lamm, Sheikh and Carter (2017) conducted a study on identification of strategies to increase the motivation of students, their connection with the material, and retention of the content, has been very important within leadership education. The findings of the study revealed that 15% and 28% of the variance in Goal Orientation dispositions was predicted by personality factors, confirming the predictive nature of the relationship.

Sosik, Chun and Koul (2017) examined the direct and interaction effects of students' learning and performance-avoidance Goal Orientations on their psychological wellbeing. Gender is used as classificatory variable and covariates are the grade point average and academic program. The sample of the study consists of 564 freshman college students in a Thai university. The results of study indicate that students' psychological wellbeing to be positively related to their learning goal orientation and negatively related to their performance-avoidance goal orientation. Additionally, the negative relationship between students' performance-avoidance goal orientation and psychological wellbeing was stronger for men than women. Lastly, differences in students' psychological wellbeing between men and women became more pronounced with increases in learning goal orientation for students with low levels of Performance-Avoidance Goal Orientation, but not for students with high levels of Performance-Avoidance Goal Orientation.

Tian, Yu and Huebner (2017) examined the multiple meditational roles of academic social comparison directions (upward academic social comparison and downward academic social comparison) on the relationships between Achievement Goal Orientations (mastery goals, performance-approach goals, and performance-avoidance goals) and subjective well-being (SWB) in school (school satisfaction, school affect) in adolescent students in China. A total of 883 Chinese adolescent students completed a multi-measure questionnaire. Structural equation modelling was used to examine the hypotheses. Findings of the study showed that mastery and performance-approach goal orientations had a statistically significant, positive correlation with SWB in school whereas performance-avoidance goal orientations had a statistically significant negative correlation with SWB in school among adolescents; upward academic social comparisons mediated the relation between the three types of achievement goal orientations and SWB in school and downward academic social comparisons mediated the relation between mastery goal orientations and SWB in school as well as the relation between performance-avoidance goal orientations and SWB in school.

He, Yao, Wang and Caughron (2016) studied the influence of Goal Orientation Structure on failure feedback and individual creativity. The study followed survey design with 345 R & D employees as sample and their supervisors in five Chinese high-tech companies. The results indicated that (a) supervisors' failure feedback positively correlates with incremental and radical creative performance, (b) learning goal orientation strengthens the relationship between failure feedback and creativity, and (c) avoidance goal orientation attenuates the relationship between failure feedback and creativity. The findings suggest that Goal Orientation play roles in optimizing failure feedback effects on creativity outcomes.

Ramnarain and Ramaila (2016) investigated the Achievement Goal Orientation of first year physics students at a South African University. The mixed methods design involved a quantitative survey of 291 students using an achievement goals questionnaire and individual interviews of selected participants. Findings indicated that the students perceived stronger mastery goals orientation than performance goals and performance avoidance goals orientations. The mastery goal indicated that the participants' perceptions of teacher and peer goal emphases made the largest unique contribution to their orientation in multiple regression analysis. Finally it cleared that at the tertiary level such an orientation should be promoted through learning experiences such as inquiry-based learning, which has been associated with this type of orientation.

Sahin, Topkaya and Kurkcu (2016) examined variations in achievement Goal Orientations in Turkish high school students according to the sex and age differences. Participants of the study consisted of 386 female and 250 male high school students. The data required for the study is collected 2x2 Achievement Goal Orientation Scale. The results of the Two way ANOVA suggested that there was no difference between boys and girls in achievement goal orientation dimensions; whereas the older students were more likely to less mastery and performance approach oriented than younger students.

Skaalvik and Federici (2016) studied the interaction effect of Mastery And Performance Goal Structures in Mathematics classrooms when predicting students' goal orientations. The Participants of the composed of 1628 students studying 5th to 10th grade from one large city in Norway. The data were analyzed by means of multiple regression analysis. The findings of the study revealed that the association between a mastery goal structure in the mathematics classrooms and students' personal goal orientations were significantly moderated by the degree of performance goal structure of students.

Subasi and Tas (2016) studied the coping strategies of middle school students in science classes in relation to students' Goal Orientations and motivating tasks conducted in the classroom environment. The participants of the study consist of 316 middle school students receiving education in Erzurum province of Turkey. A quantitative research methodology with non experimental design is followed. Correlation analysis and hierarchical regression were used for statistical analysis. The data were collected using Demographic Information Questionnaire, Academic Coping Inventory, Achievement Goal Questionnaire, and Survey of Classroom Goals Structures. Findings of the study indicated that a higher perception of motivating tasks provided in the classroom environment is positively related to positive coping strategies and negatively related to projective coping strategies. In addition it explains the students with higher mastery-approach goal orientation tend to utilize more positive coping strategy and less projective coping strategy and non-coping strategy. Finally the study found that mastery-avoidance goal orientation is negatively associated with positive coping strategy and positively associated with projective coping and non-coping strategies and the students with higher performance-avoidance goal orientation have a higher tendency to use positive coping strategy.

Sicak and Arslan (2016) investigated the relation between prospective teachers' Goal Orientations and academic e-dishonesty behaviours, and also the effects of their Goal Orientations on academic e-dishonesty behaviours. This research was conducted with correlational method. The Participants of the study were 669 prospective teachers. The data were collected with Goal Orientation Scale and academic e-dishonesty scale. Statistical analysis consists of Pearson product-moment correlation and stepwise regression analysis was conducted to reveal the prospective teachers' goal orientation scores' predictive power on their academic e-dishonesty scores. The result of the study revealed that, negative, weak, and significant relation was found between learning goal orientation and plagiarism, falsification, delinquency and unauthorized help which are sub-dimensions of the academic e-dishonesty scale. Furthermore the positive, weak and significant relation was found between performance avoidance and all of the sub-dimensions of the academic e-dishonesty scale. The most powerful and significant predictor of all of the sub-dimensions of the academic e-dishonesty scale of the prospective teachers' is performance-avoidance orientation.

Han, Yin and Wang (2015) explored the relationship between tertiary teachers' Goal Orientations for teaching and their approaches to teaching in China. The sample of the study consisted of 262 Chinese tertiary teachers and the results of the study indicated that teachers are highly adopted towards mastery approach and students are on performance approach. Teachers with more than five years of experience scored higher on ability approach and ability avoidance goals in teachers with more than five years experience. The study revealed that ability goals significantly predict teacher focussed learning and performance goals predict students-focussed approach in teaching.

Shatz (2015) studied the negative impact of Goal Oriented instructions. The participants of the study consisted of three groups with total of 526 students and followed experimental design. The experimental group taught with mastery oriented instructions and the other group dealt with outcome oriented instructions. Findings of the study showed that learning-oriented instructions led to lower performance levels, while outcome-oriented instructions reduced participants' language risk-taking, both of which negatively impact learning. The control group had the best overall results, indicating that it is better to refrain from using goal-oriented instructions in learning tasks.

Chen and Wong (2015) explored the variations in Goal Orientation according to certain contextual variables. The main aim of this study was to identify the relationship between goal orientation and grade point average during their college and school period from 7 onwards. Sample of the study consist of 312 college students from Hong Kong. Study followed a survey design to gather information regarding goal orientations, their college GPA and their average scores in high school. Technique of structural equation modelling was used for data analysis and the findings revealed that Mastery And Performance Approach Goals were positively associated with GPA of college students, whereas performance-avoidance goals were negatively associated with GPA. In the case of average scores both PAPGO and PAVGO were positively associated and mastery goal had no association.

Jowkar, Kojuri, Kohoulat and Hayat (2014) studied the influence of Academic Goal Orientation on academic resilience. The participants were 606 students (307 girls and 297 boys) selected from Shiraz high schools. The data required for the study is collected by the Achievement Goals Questionnaire and Youth Development Module Scale (RYDM). To analyze the data, Pearson Product–Moment Correlations and Multiple Regression were performed to investigate the relationship and the prediction of academic resilience by achievement goal orientations. Findings of the study revealed that mastery-approach was a significant positive predictor of the home care/high and peer care subscales of resilience. The performance-approach was a significant, positive predictor of home care/high and school/ community meaningful was predicted by performance-avoidance positively.

Mahasneh (2014) is examined the relationship between Goal Orientation and Parenting Styles. The sample of the study consisted of 650 secondary school students. The data required for the study were collected by using goal orientation and parenting styles questionnaires. The data were statistically analysed using regression and correlation analyses. Results of the study indicated that there is a significant positive correlation between Learning Goal Orientation and authoritative, authoritarian and permissive parenting styles. Performance-prove orientation is positively related to authoritative, authoritarian and permissive parenting styles and the performance-avoid orientation is positively related to authoritative, authoritarian and permissive parenting styles.

Zhang (2014) studied the effectiveness of autonomous inquiry model and its influence on the construction of Chinese students' Goal Orientations in English. The relationship between learning goal orientations and language instruction is explored in the English as Foreign Language environment. The results indicated that in the autonomous inquiry model, the performance of English language teaching can be improved significantly; moreover, in China, most learners have performance goals in contrast with Mastery Goals and Performance Goals enhance the teaching performance definitely.

Akin (2012) explored the relationship between Achievement Goal Orientation and age. The sample of the study comprised of 497 high school students with 164,160 and173 from 1st, 2nd and 3rd grades respectively and 473 university students with 131,127 and 109 from 1st, 2nd and 3rd grades respectively. Tools used for data collection was a demographic data sheet used to seek information regarding age, sex academic year and GPA and achievement goal orientation scale (Akin, 2006). Analysis of data was done with t-test and ANOVA. The results of the study showed that there exist significant differences between high school and university students in achievement goal orientation. Also the participants with lower age are adopted toward performance-avoidance goal while students coming under higher age category were learning approach oriented. Again the study confirmed that elder students less adopted performance-avoidance orientation and younger students less adopted on learning avoidance orientation. So the study concluded that learning goals increased with age where as performance goals decreased with age.

Al-Harthy and Was (2012) identified the relationship between Goals, self efficacy and Metacognitive self regulation and examined the joint contribution of each variables on students score in 12 exams. The study utilized a path analysis model. Results revealed that self efficacy, self regulation, task value and elaboration showed significant positive correlation with total score. Self efficacy and mastery goals were positively predicted the total score, but performance avoidance goal was negative predictor. Again the study identified direct positive relationship between mastery goal and metacognitive self regulation. In addition performance approach goal was a weak predictor of the variables of the study.

Geta (2012) investigated the relationship between achievement Goal Orientation (mastery, performance-approach and performance-avoidance) on cognitive styles. A survey design was employed for the study and the sample of the was 410 higher secondary students selected by stratified random sampling technique. Scale of Goal Orientation and personal style inventory were used for data acquisition. Findings of the study revealed that goal orientation of higher secondary school students was found to be varying in relation to gender, year of study, subject specialization and type of school. The study also noted that cognitive style was significantly influenced by achievement Goal Orientation.

Kahraman and Sungur-Vural (2012) investigated the relationship between students' personal achievement goals and their perceived parents' goal emphasis in science. The study followed survey methodology and the sample of the study was 295 seventh grade elementary school students. Achievement Goal questionnaire (Elliot and Mc Gregor, 2001) and perceived parent goal emphasis scale (Friedel, Corhna, Tuner and Midgley, 2007). Findings of multiple regression analysis revealed that most of the students adopt Mastery Approach Goals in science and identified an interaction between perceived parents' goal orientations. Furthermore, students Performance Approach Goal was significantly predicted by perceived Performance Approach Goals emphasis.

Edwards (2010) examined the effect of Achievement Goal Orientation on attention, learning and Metacognitive Awareness. It was an experimental study conducted on one hundred and twenty under graduate students studying in educational psychology course. At the initial stage the pre test measures of reading, questionnaire on interest and an interview to assess metacognition were collected. Covariates of the study were students' personal goals, prior knowledge and reading ability. Finally after experimentation the post test measure of attention, comprehension and Metacognitive Awareness were taken. Major statistical techniques used for the study were ANOVA, standard regression analysis and path analysis. Major results of the study indicated that achievement goals and learning was partially mediated attention. Whereas metacognition was significantly mediated goals and learning, Mastery Goals leads to better metacognition of learners.

Culbrtson, Smith and Leiva (2011) conducted a study on influence of Goal Orientation and self efficacy in predicted the entrepreneurial and managerial career anchor development. The participants of the study consisted of 158 undergraduate students (64 males and 94 females). The measures used for the study were Goal orientation inventory (Vandewalle's, 1997), General self efficacy scale (Chen, Gully and Eden, 2001) and entrepreneurial and managerial goals are measured by career orientation inventory (Schein, 1985). Findings from the analysis of data indicated that Learning Goal Orientation, performance prove orientation and high self efficacy significantly predicted entrepreneurial development. But managerial goals were not influenced by self efficacy and achievement Goal Orientation.

Steinmayr, Bipp and Spinath (2011) studied the influence of Goals, intelligence and personality on academic performance of students. The study followed survey design with sample of 520 eleventh and twelth grade students. The instruments used for the study consisted of self report measure of goals (Spinath et al, 2002), the big five factors of personality (Borkenau and Ostendorf, 1993) and Cattell's culture fair test of intelligence were used. Regression analysis showed that school academic performance was significantly predicted by intelligence, openness to experience, conscientious and Learning Goals, where as academic performance was partially mediated by Performance Goals.

Matuga (2009) investigated the relationship between self regulation, Goal Orientation and academic achievement of secondary students who are enrolled in online university courses in science and explored the changes in self regulation and Goal Orientations of these students. Participants of the study were 40 secondary students who accepted the post secondary online corridor project (PSOLC). Out of the total sample, 32 were female students and 8 were male students. data collection procedure consist of (1) exploration of motivation for entering PSOLC (2) focus group discussion with experts to know the effectiveness of PSOLC project and achievement (3) evaluation of project and pre and post test measure of Motivational strategies for learning questionnaire(MSLQ) were conducted to explore the changes in motivation and self regulation. Academic achievement was indicated through final grades of examination. Results of the study indicated that 95%of the participants successfully passed the online course in science. Furthermore there is a significant difference in motivational orientation before and after project was noticed but in self regulation most of the students have moderate level and there is no significant difference in mean of self regulation before and after PSOLC project.

Countinho (2007) examined the relationship between achievement Goal Orientation, Metacognition and academic success of students. The study employed survey methodology and the participants were 179 undergraduate students (87 female and 92 male) having the age in between 18 to 40 years. The instruments used for data collection was Goal Orientation inventory (Roedel, Schraw and Plake, 1994), Metacognitive Awareness inventory (Schraw and Dennison, 1994) and demographic information sheet and GPA from college were collected. Results from multiple regression analysis revealed that Mastery Goals are related to GPA whereas performance goals are unrelated to GPA. Also students with high Metacognitive Awareness have good GPA than those with low Metacognitive Awareness.

Kadhiravan (2007) investigated the influence of Goal Orientation and cognitive styles. The study followed survey design. Sample of the study was 410 higher secondary school students selected through stratified random sampling technique. Instruments used for the collection if data include Goal

Orientation Scale and Personal Style Inventory. Findings from the analysis of data indicated that cognitive style of higher secondary school students was significantly influenced by Goal Orientation. Also Goal Orientation was found to be varying in relation to sub samples gender, year of study, subject specialization and type of school.

Gutman (2006) examined how students and parents Goal Orientations and perceived classroom goal structures influence self efficacy and achievement in Mathematics during high school transition period. This study followed a longitudinal design in which data were collected during the last year of elementary school and then again each year until the first year of high school. Participants are 50 adolescents (24 female and 26 male) and 50 parents with low income families. The instruments used for the study was patterns of adaptive learning survey(PALS, Midgley et al, 1997) for collecting student data and a single open ended question and interview were used to collect data from parents. Correlation analysis, multiple regression analysis and ANOVA are the major statistical techniques used in the study. The result of the study revealed that students with mastery goal orientation in classroom are more positive in mathematics self efficacy and achievement than their peers. Also parents with Mastery Goals had higher grade than parents of their peers with no Mastery Orientation. The study suggested that Mastery Goals are significant in improving achievement and self efficacy in Mathematics than Performance Goals.

Mattern (2005) conducted a study on comparison of students' Goal Orientation and achievement. The study was conducted on approximately

80-90 students doing human development course. In the initial stage of data collection, students were asked to get consent and required to complete a portion of MSLQ during the regular periods. At the end, students' final course grades were collected. Participants included in the study hold high performance goals and high mastery goals. Results from ANOVA indicated that there is no significant difference between multiple goal orientation group and single goal group. But there is a significant difference between mastery and performance was noted.

Day, Stokes and Fein (2002) explored whether Goal Orientation predict the complex skill acquisition and identified the influence of context on it. Participants of the study included 98 males undergone seven hours of training to learn a computer based task. Materials used for data collection was video game space fortress (SF) to measure complex skill acquisition (Mane and Donchin,1989), General cognitive ability(g) by Raven and Court, 1994 and goal orientation by Vandewalle's (1997) and a computerized structural assessment technique (Schavaneveldt, 1990). Training outcomes measured in the study was declarative knowledge, knowledge structure accuracy, skill acquisition, skill retention and skill transfer. Findings of the study revealed that both performance approach and avoidance contribute to training outcomes beyond general cognitive ability (g). Learning goal orientation neither correlated with any of learning outcomes both for knowledge structures and all the skill based training outcomes.

Li, Ling and Culjak (2001) investigated the relationships between Goal Orientation and cognitive strategies, school failure coping style, school achievement, in order to probe into the role that goal orientation played in self regulated learning. Based on the result, it was hypothesized that Goal Orientation served as the impetus variable in self regulated learning, influencing the cognitive strategies which the subjects adopted to deal with the cognitive materials, and the coping style which the subjects selected when facing school failure; while the cognitive strategies and coping style directly influenced the school achievement.

Pintrich (2000) studied the role of multiple goals and their links to multiple outcomes of motivation, affect, strategy use and performance. Data were collected over 3 waves from 8th and 9th graders (N = 150) in their math classrooms using both self-report questionnaires and actual math grades. There was a general decline in adaptive outcomes over time, but these trends were moderated by the different patterns of multiple goals. In line with normative goal theory, Mastery goals were adaptive; but also in line with the revised goal theory perspective, Approach Performance Goals, when coupled with Mastery Goals, were just as adaptive.

Wolters, Shirley and Pintrich (2000) identified the relations between three Goal Orientations, students' motivational beliefs and self-regulated learning. It is a correlational study of 434 seventh and eighth grade students. Data were collected over two time points (fall and spring) within one school year with self-report questionnaires. Regression analyses revealed that adopting learning Goal Orientation and ability goal orientation resulted in a generally positive pattern of motivational beliefs including adaptive levels of task value, self-efficacy, and test anxiety, as well as cognition including higher levels of cognitive strategy use, self regulation, and academic performance. Results showed that adopting an extrinsic goal orientation led to more maladaptive motivational and cognitive outcomes. These findings were replicated across three different academic subject areas of English, Maths and Social Studies.

Studies on Learning Styles

In this section studies related with Learning Styles are presented in the chronological order.

Ishak and Awang (2017) investigated the relationship between Learning Styles and student's achievement in History subject of secondary school students. Survey method is adopted for the conduct of the study. Sample comprised of 200 students from two schools in the district of Kulim, Kedah. Six different learning styles proposed by Grasha is identified and its relationship with achievement in History subject were determined. Gender is the classificatory variable. The results of t-test and Pearson correlation analysis showed no difference between learning styles based on gender and no significant relationship between Learning Styles and achievement of student in History subject.

Lake, Boyd & Boyd (2017) conducted a study on what current researchers and previous researchers talking about Learning Styles. For most of the researchers' encounters with the term 'Learning Styles' it is dependent on the tradition and the context from which the term has originated. For a new researcher learning style can be a confusing and potentially time consuming process to correctly identify the differences in the terminology. The main focus of the study is on the question should the term 'learning style' be considered as the overall generic term that researchers use to define student learning dimensions? The researcher identified that 'learning styles', 'learning patterns', or 'learning dimensions' are the terminology in learning and all these terms imply single thing. Furthermore, the researcher provides an overall nature of its origin, development and assessment which directs the future researchers.

Rahman and Ahmar (2017) conducted a descriptive study using cross sectional design. The study examined the relationship between Learning Styles and learning outcomes by gender. The population in this study were all students in 1st year of SMAN 1, Indonesia, in the 2014/2015 academic year. Test of modalities learning styles (TMLS) is used to determine whether the students' Learning Styles are visual, auditory and kinaesthetic (VAK) and documentation analysis were the instruments used in this research. The data were analysed with the chi-square test and two-way ANOVA. The results revealed that women are dominated by the visual and auditory learning styles and there is no significant relationship between Learning Styles and learning outcomes by gender and no significant interaction between Learning Styles with learning achievement based on gender.

Ozdemir and Kaptan (2017) carried out an exploration the Learning Styles of pre-service primary school teachers. Research used Survey model with 1124 pre-service primary school teachers as 694 (61.74%) of them are females and 430 (38.25) of them are males have composed the sample. For determining the Learning Styles of the pre-service primary school teachers Kolb Learning style scale is used. The analysis of the data indicated that least preferred Learning Style of primary teachers is described as accommodating and converging is the dominant Learning Styles of pre-service primary school teachers.

Yazici (2017) investigated the relationship between social studies pre-service teachers' learning style, test anxiety and academic achievement. A total of 315 social science pre-service teachers participated in the study. Data were collected using Turkish versions of Grasha-Reichmann learning style scale (GRLSS) and test anxiety scale (TAS) by Spielberger. According to the findings, academic achievements had negative and low-level relationship with the TAS' worry sub-dimension while they had no significant relationship with the emotionality sub-dimension. No statistically significant relationship was observed between test anxiety and independent, participant and avoidant Learning Styles, which are among GRLSS sub-dimensions. The findings revealed TAS sub dimension had had positive, low-level and significant relationship with that competitive and cooperative learning. The relationship Learning Styles and test anxiety based on gender and class level was also investigated in this study.

Thakur, Vij and Shri (2017) carried out a meta-analytical review of Learning Styles/Preferences. The study explored that literature is enriched with learning theories and different learning/cognitive styles. All these works stressed that Learning Style is individualistic and each learn differently; therefore teachers should teach different kinds of learners differently. The matching between learning style and teaching style and its Pedagogical implications for administering learning style inventories in educational institutions are also discussed. The study provides emphasis to neuro-linguistic programming and it suggests visual, auditory and kinaesthetic modalities and its recommendations for optimum learning by VAK modes.

Balakrishnan and Gan (2016) investigated whether the students' varying Learning Styles affect the use of social media for learning based on two learning styles, which is independent and collaborative. The students' perceptions after using a social media enabled tool is identified by using Questionnaires which was specifically developed based on three key factors; Self, Effort and Function. A total of 48 students with Computer Science background were recruited to participate in the experiment. Path modelling analyses indicate the factors to predict 70% and 59% of usage among the independent and collaborative groups, respectively. Results showed that collaborative students emphasize more on Function and Effort than Self, whereas Self and Effort had stronger impacts on the independent students than Function. Pair-wise comparisons revealed the differences between the Learning Styles to be significant for Self and Function, that is Self to be more important for independent students whereas Function was more important for the collaborative students. No significant differences were noted for Effort.

Cheema and Kitsantas (2016) investigated the predictiveness of preferred Learning Styles (competitive and cooperative) and classroom climate (teacher support and disciplinary climate) on learning strategy use in mathematics. The student survey part of the Programme for International Student Assessment 2003 comprising of 4633 US observations was used in a weighted ordinary least squares multiple regression framework to predict learning strategy from preferred Learning Styles and classroom climate while controlling for self-efficacy and demographic variables. The findings of the study inferred that the preferred Learning Styles were the most important predictors of learning strategies used in Mathematics.

Kiblasan, Abufayed, Sehari, Madamba and Mhanna (2016) investigated the relation between Learning Style and study habit of students in the Faculty of Nursing according to their gender, year level and age group. A mixed method of research was used and the data gathering tool used to assess variables consisted of VAK Learning Style Inventory (LSI) and the Study Habit Inventory utilizing the study attitude inventory (SAI). The result of the study revealed that BSN students found to be visual learners and have the motivation as the most scaled study habit. The learning style and study habit is varied according to demographic profile and there is a strong relationship between the Learning Style and study habit among BSN students.

Ababneh (2015) carried out a comparative study of the Learning Styles of successful and unsuccessful language learners. The sample of the study comprised of seventeen graduate university students at Yarmouk University, Jordan. On the basis of their final scores on English examination administered at the end of the semester, they were differentiated as 'successful or 'unsuccessful' learners, and their oral presentations which they had to give during the semester to measure their ability of speaking, discussing and defending themselves in English appropriately. The data required for the study is collected by using a questionnaire. Results of statistical analysis showed that there was no significant relationship between learning styles and their proficiency or achievement in English. Finally the study also suggested some key differences in the Learning Styles of sample.

Khaki, Ganjabi and Khodamoradi (2015) investigated whether different Learning Styles play a role in grammar classroom taught through promptive focus on form instruction. The participants of the study consist of 64 female students studied in a state pre-university centre. Paragon learning style inventory was used to collect data regarding learning style. The results of the study indicated that there is no difference in the Learning Style and performance in grammar because of the focus on form instruction.

Fayombo (2015) investigated the learning preferences (visual, auditory, kinesthetic), the teaching strategies (videos, games, role-play, discussion, group work, clarification pauses, five minute-paper, and discussion forum and glossary activity) and their influence on the academic achievement of 171 undergraduate Psychology students at the University of the West Indies, Cave Hill Campus, and Barbados. The participants completed three self report instruments: a) Active Learning Strategies Questionnaire, b) Learning Style Survey (VAK) and c) Academic Achievement Scale. Findings revealed students' preferences for visual, auditory, kinesthetic and multiple modes of learning styles and the majority of the students benefited from the learning strategies utilised in the classroom. Additionally, the teaching strategies and learning styles contributed 20% to the variance in academic achievement and this was statistically significant.

Liu and Shi (2015) explored the Learning Style preferences of 1701 Chinese University learners in terms of general patterns, gender, and discipline differences. After administering the 44-item Felder Silverman Index of Learning Styles (ILS) to the participants, the study revealed the following findings; The scales for measuring ILS were reliable and valid; most of the Chinese university students tended to be sensing, verbal, global and active learners; male and female students were significantly different on Visual-Verbal, Sequential Global and Active-Reflective and there exist significant differences in Learning Styles between students of different disciplines. Therefore gender and discipline had a significant impact on students' Learning Style preferences.

Nzesei (2015) conducted a study on the relationship between Learning Style and academic achievement among secondary school students in Kenya. Purposive sampling technique was used and the data collection instrument was the Barsch Learning Style Inventory (BLSI). This inventory identified the learning style preference among the students based on Visual (V), Auditory (A) and Kinesthetic (K) modalities. The results of the study revealed that majority of the students are trimodal learners, followed by bimodal (VA) learners and thirdly by unimodal (V) learners and the least preferred learning style is the single kinesthetic modality which was preferred by only 2 female students. The learning style preference is not differed according to the gender and high and low academic achievement groups. Learning styles and academic achievement showed a strong, positively relationship for the tri modal learners, and among male and female students.

Najarkolai, Beigzadeh, Motlagh and Sabzevari (2015) studied the relationship between the Learning Styles of postgraduate students in Kerman University of Medical Sciences and their baseline characteristics. Methods used for the study was cross-correlation study and the sample consist of 400 postgraduate students of Kerman University of Medical Sciences were randomly selected. To collect data, the Kolb's learning styles questionnaire was distributed among the participants. Descriptive statistics (percentage, frequency, mean, and standard deviation) and analytical tests (ANOVA and chi-square) were performed to analyze the data. The findings indicated a significant difference between learning styles; most postgraduate students at Kerman University of Medical Sciences used the converging learning style. Totally, 51%, 31%, 10%, and 8% of the participants used convergent, assimilator, accommodator, and divergent Learning Styles, respectively. No statistically significant relationship was found between the Learning Styles and baseline variables.

Singh, Kovil and Rani (2015) attempted to find out the relationship between preferred Learning Style of students and the variations according to demographic variables like gender, place of living, religion and parents' educational level. The study was conducted on the sample of 300 secondary school students of Aligarh District. Data required for the study is collected by using 'Learning Style Inventory' developed by Jaffery Barsch (1996). The Chi- Square test was employed to analyze the data. The results of the study revealed that the most preferred learning style of secondary school students was Visual (45.7%) followed by Auditory (21%), Tactile (18.3%) and kinesthetic (15%). Moreover, the study revealed that there was no significant impact of certain demographic variables like gender, place of living, religion and educational level of father on the learning style preferences of secondary school students. But significant impact of mothers' educational level on the Learning Style Preferences of these students was reported in the study.

Seyal, Mey, Matusin, Siau and Rahman (2015) conducted a study on students' Learning Style, attitudes about educational technologies in general and e-learning management system (e-LMS) in particular and their behavioural intentions to use the e-learning platform in a single institution of higher learning in Brunei Darussalam. In this study, a survey, using the VARK Questionnaire as a tool to describe the learning styles of students, was conducted among 120 students. The data analyzed through SPSS confirmed that there existed a relationship between students' learning style (Kinesthic-doing), their attitude towards e-LMS and their intention to adopt university's e-learning platform "Ask-n-Learn". Recommendations were made in order to enhance pedagogy in the context of e-learning.

Surjono (2015) carried out an experimental study for investigating the effects of multimedia preferences and Learning Styles on undergraduate student achievement in an adaptive e-learning system for electronics course at the Yogyakarta State University Indonesia. The results of the study indicated that students in which their multimedia preferences and Learning Style matched with the way the material presented in online electronics course have higher scores significantly compared to those in which their learning mode were mismatched. The difference happened both in adaptive and non adaptive online courses.

Wu (2014) conducted a correlational study to incorporate the features of Learning Styles in distance education. The participants of this study were students enrolled in three sections of the contemporary worldviews course at a private higher education institution (HEI). The Learning styles were determined as visual, auditory, read/write, and kinesthetic (VARK) framework. The responses were marked on the format determined from one composite question with responses based on a Likert scale. The result of statistical analysis revealed that learning styles were not significantly correlated with satisfaction of course format.

Khalid, Mokhtar, Omar-Fauzee, Kasim, Abdussyukur and Geok (2013) determined the variation in Learning Style Preferences and identified the relationship between Learning Styles and academic achievement of arts and Science stream students. It followed a survey design and the data were collected form sample of 100 students with age groups sixteen and seventeen years. Grasha-Reichmann Learning Style Scale and a demographic profile to collect information regarding age, gender, socio-economic status etc were the measures used for collecting the data.

Statistical techniques used for analysis was t-test and ANOVA. Findings of the study showed that there is no significant relationship between learning style and academic achievement in arts and science stream students. In addition students from arts and science students mostly prefer dependent learning style followed by co-operation and they do not differ on the basis of demographic variables.

Vaishnav (2013) conducted a study on Learning Styles prevalent among secondary school students and to find out relation and effect of different Learning Styles on academic achievements of students. The learning styles identified under this study are visual, auditory and kinesthetic (VAK) styles. The participants of the study consisted of f 200 students of class 9th, 10th and 11th standard of Maharashtra state. The results of the study indicated that Kinesthetic Learning Style was found to be more prevalent than visual and auditory learning styles among secondary school students. In addition to this, the study found that kinesthetic learning style and academic achievement showed a positive high correlation. The main effects of Visual, Auditory And Kinesthetic Learning Styles with academic achievement are significant.

Williams, Brown and Etherington (2013) identified the Learning Style Preferences of under graduate students pursuing Bachelor of pharmacy course. The study was conducted on a total sample of 900 students selected through convenience sampling method. Data required for understanding learning style preferences was acquired with help of standard instruments; Kolb Learning Style Inventory, Index of Learning Styles, Success Types

Learning Style Type Indicator and Self Report Demographic Questionnaire was used to seek information regarding age, class level and gender etc. The findings indicated that learning styles preferred by most of the pharmacy students are Assimilator, active-Reflective and Introverted, Intuitive, Feeling, Judging (INFJ)/Extroverted, Intuitive, Feeling, Judging (ENFJ) styles. Same authors duplicated the study among undergraduate students of social work by using the above referred tools. The findings revealed that most of the students of social work favours converging and assimilating, intuitive and sensing, thinking, judging and perceiving styles.

Bayrak (2012) conducted a study on influence of gender and class level on Learning Style of secondary school students. Sample of the study composed of secondary school students of a state elementary school registered at the ministry of national Education in Istanbul. Tools used for collecting the data were Grasha-Reichmann Student Learning Style Scale, 1994. Results of the statistical analysis revealed that majority of secondary school students (48%) participated in the study had competitive learning style. There existed significant difference in Learning Style on the basis of gender where as with respect to class level no significant difference was found.

Caliskan and Kilinic (2012) examined the relationship between learning style and the attitude towards social studies course. The study was conducted on a sample of 320 primary school students. Measuring instruments used for the study was Perceptual Learning Style Preference Survey (Ried, 1987) and attitude scale for social studies course (Caliskan, 2009). Results of the study indicated that there is positive, moderate relationship was found between Learning Style and attitude toward social science course. In addition there existed a significant difference in Auditory; Kinaesthetic and Tactile Learning Style Preferences on the basis of class level, but there is no significant difference in other preferred learning styles.

Tulbure (2012) identified and compared the Learning Style preferences, teaching strategies (Graphical, Organization of information, Co-operative learning, Investigation, Debate and Problem Solving) and academic achievement among two groups (educational science and economic science) of pre-service teachers. This was a survey study consisted of total 182 pre-service teachers (85 from educational science and 97 form economic science). Instruments used for the study was adapted version of Kolb's Learning Style Inventory (lussier, 1990) and academic achievement was measured with help of grades in five summative assessment test. Findings showed that significant difference was observed between the students with different learning style when followed co-operative learning strategy was implemented. Also problem solving strategy is more suitable for accommodator of educational science category than economic science category. There is no significant difference in achievement in the case of assimilators for both the groups.

Gujjar and Tabassum (2011) assessed the Learning Styles of student teachers and determined significant differences with respect gender and class. The study was conducted on a sample of 230 student teachers studying at federal college of education, Islamabad and was selected by random sampling technique. Grasha-Riechmann Learning Style Survey was used to assess the learning styles and the collected data were statistically analysed by using the techniques t-test and ANOVA. Six types of learning styles as independent avoidant, collaborative, dependent, competitive and participant can be identified with help of the instrument. Results of the study showed that participants are high in avoidant, competitive and collaborative and low in independent, dependent and participant styles. For the sub samples female students are higher than male students in all learning style except in avoidant. Also students are differing in learning styles in class wise on all types of Learning Styles.

Jilardi Damavandi, Mahyuddin, Elias, Daud, & Shabani (2011) investigated the impact of Learning Styles on the academic achievement of secondary school students in Iran. The Kolb Learning Style Inventory (1999) was administered in eight public schools in Tehran. The mean of test scores in five subjects, namely English, Science, Mathematics, History and Geography was calculated for each student and used as a measure of academic achievement. A total of 285 Grade 10 students were randomly selected as sample of this study. The results of the analyses of variance showed that there is a statistically significant difference in the academic achievement of the Iranian students that correspond to the four Learning Styles [$F(3, 285) = 9.52$, $p < .05$]; in particular, the mean scores for the converging and assimilating groups are significantly higher than for the diverging and accommodating groups.

Rahman, Abdullah, Yasin, Meerah, Halim and Amir (2011) identified the differences in Learning Styles and strategies for promoting metacognitive development in the classroom. This was a descriptive research and participants of the study included 161 secondary school students (71 male and 90 female) studying in Malaysia. Data required for the study was collected by using the tools; Learning Style Inventory (Dunn & Dunn, 1999) and students' perception of implementation of metacognitive development activities in the classroom. Results of the study indicated that secondary school students regardless of their Learning Styles mostly preferred are emotional support, teacher encouragement, motivation and student voice.

Clarke, Lesh, Trocchioand and Wolman (2010) identified the relation between Sternberg's thinking style and Felder- Silverman's Learning Styles. The sample of the study consist of ninety five graduate students with specialisation in special education, reading, educational leadership, curriculum and elementary education studying in a private university of south- east Florida. Data required for the study was collected by using questionnaires namely TSTI (Grigorenko & Sternberg, 1993) and the Index of Learning Styles-ILS (Felder & Silverman, 1988; Felder & Soloman, 1994). Findings of the study indicated that three styles of thinking in Sternberg's self local, conservative and executive were associated with the sensing and sequential learning styles. Differentiation between doctoral and master students could not be done by using TSTI, where as ILS differentiate these groups. Sample of the study differ in thinking and Learning Styles in accordance with area of specialisation.

Yilmaz-Soylu and Akkoyunlu (2009) conducted a study on effect of Learning Styles and learning environment on achievement. The method used for the study was pre-post test experimental method. The learning environment (Text based learning environment, narration based learning environment and computer mediated learning environment) are set up and learning style was measured with Kolb's Learning Style Inventory and pre and post test measures of a multiple choice test were used for collecting data from 39 students from computer science and educational sectors. Data were analysed by using the statistical technique ANOVA and the results revealed that Learning Style in different learning environment was not significantly influences academic achievement.

Nelson-Smith (2008) examined the influence of Learning Styles, perceptions of teachers, attitude and learning environment on truancy of African American students. This was an exploratory cum correlational study. The sample for the study included all 9th grade students enrolled in a public school located in southern region of united state. The Index Of Learning Style Questionnaire (Felder & Solomon, 1991), demographic details, perceptions of teachers' attitude and learning environment were measured by a single test consisting of three parts constructed by the researcher was used. Descriptive statistics, cronbash's alpha and multiple regression analysis were the major statistical techniques used for the study.

Results of the study revealed that students with sibling, low grade point, having troubles related with legal matters, those who are not involved in organizations and female students were found to be highly truant than other groups. Also the whole variables considered in the study constitute 32.5% to the truancy of African American secondary students.

Dasari (2006) investigated the relationship between matching teaching styles and Learning Styles with academic achievement in science. The study followed two group post test design. The study was conducted on a sample of 32 six grade students and sixteen students assigned to experimental and control groups. The sample selection procedure was convenient sampling. Pre test scores are indicated by students test scores in the second semester examination conducted by the school and they were compared on post test scores. Dependent sample t-test was used for the analysis of data. Results of the study revealed that when teaching styles are matched to Learning Styles science achievement was improved in experimental group and if it was not matched there is no difference in achievement was observed for control group.

Studies on Science Process Skills

In this section studies related with Process Skills are presented in the chronological order.

Aydogdu (2017) conducted a study to find out the Basic Process Skills (BPS) among the primary school and its relationship with BPS and academic achievement. The study followed a survey design and the sample was 1272 primary school students. The tool used was adopted version of Test of Basic Process Skills (Padilla, Cronin and Twiest (1985). The findings of the study indicated that the BPS scores of primary school students are not at a satisfactory level. The results indicated that the BPS scores of primary school students were higher among the upper grades than the lower grade levels, students coming from better socio-economic levels than those with low level socio-economic backgrounds and students in urban areas than those living in rural areas. Furthermore, the results indicated that a positively significant relationship between primary school students' Basic Process Skills and achievement in science courses.

Barahmeh, Hamad and Barahmeh (2017) studied the effect of 'Fermi Question' strategy in the Development of Science Processes Skills among Jordanian Ninth Graders in the subject Physics. The study followed an experimental design. The sample of the study consisted of ninth grade students of a heterogeneous group of almost equal number of males and females. Sampling technique used was stratified random sampling. Experimental group was compared with a control group with traditional method of teaching. Instrument used for collection of data was science process skills test prepared by the researchers according to the purpose of the study. The test was administered before and after the treatment. The results of the study showed that experimental and control group differ significantly in SPS test and on the basis of gender difference was in favour of females.

Duruka, Akguna, Doganb and Gulsuyuc (2017) examined the role of science curriculum on Science Process Skills and identified its effectiveness as a major learning outcome. For this purpose the researcher conducted document analysis of Turkish Secondary School Science Curriculum which is revised in the year 2013. The results showed that Turkish science curriculum represented science process skills differently according to the grade level and unit.

Karacop and Diken (2017) studied the effectiveness of Jigsaw instructional strategy Science Process Skills of Prospective Science Teachers. The purpose of this study is to compare the effects of laboratory approach based on jigsaw method followed the principles of cooperative learning with a confirmatory laboratory approach. The study was finally sought to collect the opinions of the students on Jigsaw applied laboratory method. The sample of the study was University student teachers with 25 members in Jigsaw Group and 23 members in confirmatory laboratory approach. Scientific Process Skill Test and Student Opinion Scale were used as data collection instruments. The result of statistical analysis revealed that the effect of laboratory approach based on Jigsaw method is found to be better for improving science process skills that those of confirmatory laboratory approach. It was also showed that there is no statistically significant difference between groups regarding the opinions on Jigsaw applied laboratory approaches.

Prajoko, Amin, Rohman and Gipayana (2017) determined the effectiveness of the usage of recycle materials for doing science practicum in basic Science Process Skills of the Open University, Surakarta. Recycle materials are the term used for the obtained materials and equipment from the students' environment by taking back the garbage or second hand objects into goods or new products which have a benefit for practicum activities. The study was designed experimentally with randomized post test only control group. The sample of the study included 83 students, divided equally in to experimental and control groups. The instruments used for collecting data were Science Process Skills test and questionnaire. The results of this study show that recycle materials usage had a significant effect on science practicum in Science Process Skills.

Shahali, Halim, Treagust, Won and Chandrasegaran (2017) investigated the awareness and understanding of Science Process Skills of primary school science teachers. Survey design was followed and the data were collected from 329 science teachers of 52 primary schools. Science Process Skills Questionnaire (SPSQ) was used for collecting the data and the results revealed that the conceptual understanding of primary science teachers is much weak than their practical application. Another finding was significant difference in conceptual understanding of SPS according to their academic qualification but no difference based on their teaching experience.

Gomaa (2016) investigated the effect of using metacognitive strategy training on Science Process Skills and science self efficacy in learning disabled students. Experimental design with total of 60 male students with learning disability and they are equally divided in to experimental and control groups. The sampling technique used was simple random sampling. ANCOVA and Repeated Measures Analyses were employed for data analysis. Findings of the study indicated that Science Process Skills are improved of using metacognitive training strategy and science self efficacy among students.

Gultepe (2016) studied the importance, frequency of usage and difficulties faced by high school science teachers practicing in an school of Turkey. The study followed a descriptive research methodology and a survey was carried out with a questionnaire containing seven questions. Responses were qualitatively analysed and the results showed that effective implementation of Process Skills will be happened only in libraries and the skill of observing, predicting, experimenting and inferencing are the skills which are frequently used by the teachers in classrooms.

Ceylan, Sen and Vekli (2016) studied the effectiveness of Inquiry based teaching approach on self efficacy and Science Process Skills. The method used was experimental with pre-post quasi experimental design. The sample of the study consist of 24 preservice teachers belong to science stream and the tools used for collection of data was laboratory self efficacy scale, Integrated Process Skill Test and an interview. The findings of the study revealed that inquiry based teaching approach had a positive impact on self efficacy and Science Process Skills.

Yildirim, Calik and Ozmen (2016) thematically evaluated Turkish studies in Science Process Skills (SPS) from 2000 to 2015. In looking for SPS studies, the authors entered the keywords "Process Skills, Science Process

Skills, Science Education and Turkey/Turkish" in well-known databases. Further, in case the online search may have missed a substantial part of important SPS literature, the authors also conducted a manual search of the related journals. To present insights of SPS studies, a thematic matrix (needs, aims, methodologies, data collection tools, general knowledge claims, implications for teaching and learning) was used. The major themes identified by them are; development of students' and teachers' SPS, effects of significant variables on SPS achievement, integration of SPS into science curriculum and SPS measurement. Also, they identified that the inquiry-based learning approach a best one for developing SPS.

Ambross , Meiring and Blignaut (2015) explored the perceptions of primary school teachers towards the implementation and development of Science Process Skills. The study followed qualitative design with case study method with a sample of four primary school teachers from natural science sector belongs to South Africa. Data collection techniques include focus group interviews and classroom observations. Analysis of the qualitative data revealed implementation and development of science process skills were greatly influenced by the confidence of teachers and their understandings about these skills.

Aydogdu (2015) studied comprehensively about three categories of science process skills such as; Basic Process Skills, Integrated Process Skills And Overall Science Process Skills of science teachers in terms of some variables. This study had a survey design. The population of the study comprised of 170 science teachers from a province located in the Central

Anatolia Region of Turkey. The tool used for collecting data was Science Process Skills Test arranged by Aydogdu (2006). The findings of the study revealed that the Integrated Process Skills of science teachers were not at a satisfactory level. Other results revealed that Basic Process Skills of science teachers differed according to the in-service training and seniority. Whereas Integrated Process Skills of science teachers are differed on the basis of frequency of use of these skills in the classroom. In addition to this, the overall Science Process Skills of science teachers differed on the frequency of use of these skills in classroom and on in-service training on these skills.

Gultepe and Kilic (2015) evaluated differences in attainment of Integrated Scientific Process Skills of high school students of Turkey. The process skills measured are experimental designing, formation of tables, construction of graphs, interpretation of graphs, determining the variables and hypothesize formation, controlling variables. Number of students participated for the study was seventeen students in both groups and one of the group taught with scientific argumentation approach and the second group taught with a traditional teaching approach in Grade 11 Chemistry. Data required for the study was collected by using a multi format Scientific Process Skills Scale, which was administered to both groups as a pre and post-test. Data were statistically analysed by repeated t-test and analysis of variance (MANCOVA). Results showed that integrated scientific process skills of students in both groups improved significantly except skills of formation of table and interpretation of graphs. The findings from MANCOVA indicated that there was a statistically significant difference between the groups on the combination of 5 dependent variables and an overall improvement in Science Process Skills.

Guevara (2015) investigated the development of Science Process Skills through combined approaches in general Biology for higher education sector. Experimentation was conducted on two intact classes in a higher education institute in Philippines. The experimental approach with a provision of collaborative teaching and learning was compared against traditional teaching approach of teaching. Required data for the study was collected from test on previous knowledge and rubric on Science Process Skills. Findings revealed that the students exposed to the multiple representations and collaborative learning approach show significantly higher scores in the test of Science Process Skills. Also, the groups differ their scores on the bases of gender and previous knowledge in science was found to have no significant correlation with Science Process Skills.

Al-Rabaani (2015) studied the level of acquisition of Science Process Skills by pre-service teachers of Oman. The sample of the study consist of 59 student teachers from social science stream who were studying in college of education at Sultan Qaboos University and the instrument used for collecting the data was a questionnaire with 14 items under the categories of basic and integrated process skills. Data were collected using a questionnaire which consisted of 14 items under basic and integrated science process skills. From the findings it is cleared that the preservice social science teachers have average level of acquisition of Science Process Skills and there was no significant difference observed based on gender.

Abungu, Okere and Wachanga (2014) studied the effectiveness of Science Process Skill teaching approach (SPSTA) on achievement in Chemistry of secondary school students in Niyando district of Kenya. The study utilised quasi-experimental design with Solomon four groups. Sampling technique used was purposive sampling and size of the sample was 153 secondary school students selected from four schools. Students are randomly assigned to experimental and control groups and two topics were selected from the syllabus. Achievement test in chemistry constructed by researchers was used as pre test and post test measure. T-test, ANOVA and ANCOVA are the statistical techniques used for analysis of data. Findings of the study shows that SPSTA approach has significant effect on achievement in Chemistry and it enhanced the performance in Chemistry than regular teaching methods.

Erkol and Ugulu (2013) examined the level Of Process Skills of Biology teacher candidates' and their comparison in terms of variables, age, gender and grade level. The study constitutes 121 teacher candidates with 89 female and 32 male studying in Department of Biology at Balikesir University in the 2011-2012 academic years. Instruments used for data collection was Scientific Method Abilities Test (SMAT) developed by Burns, Okey, and Wise (1985) and were adapted by Bahar and Ates (2002) to Turkish language was used. Results shows that all pre-service teachers participated in the study have a medium level of Process Skills and which should be developed. Another result shows that there is no significant difference in Process Skills in terms of gender and age, but for the grade level 1^{st}, 3^{rd} and 4^{th} grades had higher process skills than 2^{nd} and 5^{th} grade teacher candidates.

Kruea and Thongperm (2014) explored current status, supports and obstacles faced by school teachers for teaching Science Process Skills in Thai context. Participants of the study was five in-service secondary school science teachers who are participated in a workshop related with process skill development and they are also attended a follow up study to understand the integration of process skills in classroom. Teachers are selected from western region of Thailand and techniques used for data collection was observation of classroom, interview and documentation. The study described that Thailand teachers are providing plenty of practical activities with a fear of covering content within the stipulated time period. Again the study identified that selective courses were highly beneficial for improving performance in Science Process Skills.

Molefe and Stears (2014) explored different views of science teacher educators in initial teacher education programmes with regard to the importance of Science Process Skills and how their beliefs of teaching influence their teaching of these skills. The study is designed as a in-depth study of the views of six teacher educators. Written responses to questions and interviews produced the necessary data. The findings revealed that teacher educators have differing opinions regarding what constitutes Process Skills and they differ with regard to the importance of such skills, they do identified certain core skills as being most important, including some generic skills.

Rauf, Rasul, Mansor, Othman and Lyndon (2013) conducted a study to understand whether teaching approaches used by the science teachers are effective for inculcating Science Process Skills and whether process skills are nurtured without formal planning to teach process skills. A qualitative case study approach was used and this was conducted on two Smart Schools of Malaysia. Sample consists of 24 students with age of 14 years and two science teachers and they were selected by stratified sampling method. Students were given an adapted Test of Science Process Skills of the original developed by the Malaysian Curriculum Development Centre (1998). Students were ranked according to their achievement score from highest to the lowest and on the basis of these scores they were divided into three groups of high achievers (85%-75%), moderate (65%-74%) and low achievers (64%-55%.). Four students were selected from each group from these two schools. The criteria for selecting the two teachers were, both teachers teach form two (age 14) students, had attended a 14 weeks Course in Teaching and Learning approach for Smart Schools. Participant and non participant observation, formal interview with teachers and for the students formal and informal interviews are used for collecting data required for the study. The study revealed that science class with various teaching approaches had advantages for inclusion of Process Skills and their inculcation does not happen without planning.

Silay and Celik (2013) evaluated the level of Science Process Skills and their differences on the basis of class and branch selected for the study. The study used 125 teacher candidates studying at Dokuz Eylul University, Faculty of Bucca as sample and the instrument used for data collection was Science Process Skill Test (SPST) constructed by the investigator. Analysis of data and findings from Mean and standard deviation indicated that all candidates had a medium level of Process Skills irrespective of their branches. So teacher candidates are not significantly differed in Process Skills according to branch of study, but with regard to class level, senior students shows higher scores than newly admitted students and the difference between the scores was significant.

Ukoh and Enyeneokpon (2013) conducted a study on determining the effect of problem based learning instructional strategy on achievement in physics and acquisition of Science Process Skills of NCE pre-service teachers. The study followed a pre-test post-test control-group quasi experimental research design, with a sample of 98 females and 94 males from six colleges of education in South Western Nigeria. Experimental group was treated to the problem-based learning instructional strategy method and control group was exposed to the conventional method of teaching. The result of the study showed that problem based learning instructional strategy had significant effect upon achievement in Physics and process skill of NCE-pre service teachers and this method help learners to explore their own learning with suitable ways.

Demirbas and Tanriverdi (2012) carried out a study to identify the level of Science Process Skill of the university science students in Turkey. The sample of the study consist of randomly chosen 556 freshmen students of universities from seven region of turkey who are undertaking the laboratory course, physics-1 during the academic year 2010-2011. Methodology of the study used the test of Integrated Science Process Skill which was developed by Burns, Okey and Wise (1985) and was translated into Turkish by Ozkan, Askar and Geban (1992) which consist of 36 multiple-choice questions with four choices. The result of the analysis shows that there exists significant variation in the levels of students for the Process Skills, hypothesizing and defining, graphic drawing and data interpretation, making operative explanations.

Karar and Yenice (2012) investigated scientific process skill level elementary education 8th grade students in relation to demographic variables like gender, the education level of parents, and the job level of parents and monthly income of the family. Method of relational scanning was used in that study. Sample of the study consist of 650 students of 99 primary schools in the district of Denzli in Turkey. Test of Science Process Skill developed by Okey, Wise and Burns (1982) was used to determine Science Process Skills and personal information forms are used to determine the demographic variables. Data were analysed by using descriptive statistics, t-test and one way ANOVA. Findings of the study show that female students are more competent in gaining Science Process Skills than male students. Also Parents with high education status, good profession and families with socio-economically high status shows a better score in Process Skill than those with low educational level, job level and poor income families.

Chabalengula, Mumb and Mbewe (2012) identified the conceptual understanding and performance of Science Process Skill of elementary pre-service teachers. The sample of the study comprises of 91 pre-service teachers who were enrolled in an elementary teacher education program conducted by a university at the Midwest of USA. Data was collected by using Science process conceptual understanding test and science process performance test. Statistical techniques like t-test, ANOVA and Pearson's Correlation Coefficient were used for data analysis. Result of analysis indicated that he conceptual understanding of pre-service teachers was low compared to their performance in Science Process Skill.

Karamustafaoglu (2011) examined the level of Science Process Skill of science and Technology student teachers by using 1diagrams which promotes the development of these skills. The sample of the study consists of 40 science and technology student teachers undergoing Instructional Technologies and Material Design course during the 2009-10 academic years at Amasya University, Faculty of Education in Turkey. Methodology of the study follows a basic experimental design with a pre-test post-test design. The translated version of science process skill developed by Enger ve Yager (1998) was used as instrument. During the study, the student teachers developed I-diagrams on science topics with the guidance of their supervisors. The results revealed that at the initial stage the student teachers shows variation in pre-tests to measure the Integrated Process Skill. At the end of the study it was observed that the student teachers' skills on developing I-diagrams were increased as well as their Integrated Process Skills problems were disappeared.

Akinbobola and Afolabi (2010) examined process skills that are prominent in the West African Senior Secondary school certificate physics practical examination in Nigeria with in the period from 1987 to 2007. Percentage analysis of basic and Integrated Process Skills were also found out. Ex post facto design was followed in the study and data was collected by using west African Senior Secondary School Certificate Physics Practical Examination Questions (WASSSCPPQ). Through the analysis of questions researchers are able to identify fifteen Process Skills and out of this fifteen, most prominent skills are manipulating (17.20%), calculating (14.20%), recording (13.60%), observing (12.00%) and communicating (11.40%). The percentages of integration of basic process skills are higher than that of Integrated Process Skills and this difference was significant. Further the study revealed that skill of manipulating was the only one Integrated Process Skills identified by the researchers.

Feyzioglu (2009) investigated the relationship between Science Process Skills with efficient laboratory use and scientific achievement in chemistry of university students. The study was conducted on a table of 180 freshman students who attended chemistry course in a public university during the academic year 2006-2007. The data collection instruments for the study are, 1. Questionnaire for students to know their opinion on process skills (SPS) 2. Efficient laboratory attitude scale ELA and the science Achievement test (SAT). Correlation, regression analysis and t-test were used for the data analysis. Findings of the study show that there exist a significant and positive relationship between Process Skills, efficient laboratory use and students achievement in Chemistry.

Saribas and Bayram (2009) determined the possibility of Chemistry laboratory method embedded with metacognitive skills for enhancing Science Process Skills and attitude towards chemistry of pre-service science teachers. The study was carried out on representative sample of 54 preservice science teachers who completed the first year chemistry lab course. Design adopted for the study was control-experimental groups both having same number of participants undergoes 11 experimental treatments under a lab course. The students comprising the control group performed the experiments following the instructions described in the laboratory manual and a pre and post discussions about the design of the experiments. Interview conducted at the beginning and the end of the semester for deeply analysing students' metacognitive skills, motivation and attitude towards the course. The result of the study indicated that experimental group outperformed the control group in the Science Process Skill Test, particularly in the categories of identifying variables, operationally defining and designing investigations. But towards the attitude there is no significant difference in gain scores for experimental and control groups, although the students reflected very positive feedbacks for the last interview form.

Aktamis and Ergin (2008) determined the effect of Scientific Process Skill Training (SPS) on scientific creativity, attitude towards science and academic achievement in science of seventh grade elementary school students. This study uses a quasi experimental research design with pre-test post-test control group. Total sample of the study was 40 seventh grade students of Buca district of Izmir province in turkey, out of the forty, 20 students' falls under experimental group and 20 under control group. For data collection purpose the investigator prepared closed- ended and open ended work sheets for the previously identified process skills through the analysis of the text books. Other standardized tools used by the investigator are 1.test of achievement in science 2. Scale of attitude towards science 3. Scale of scientific creativity (Hu and adey,2002). The data were analysed by using the statistical techniques like mean, standard deviation, independent sample t-test and paired sample t-test. Findings of the study revealed that Science Process Skill training increased achievement and creativity level of students in science, however there is no significant change in their attitude towards science when compared to those without SPS training.

Kirch (2007) explored the present understanding about how young children and teachers re/produce Process Skill during early childhood education period and to determine the extent in which scepticism moderates open-mindedness in practice during scientific investigations. Researcher used conversation analysis between the students and their teachers' in order to identify this influence. Result of the analysis shows that most of the teachers used scepticism at sometime, but there was a strong tendency to rely upon authoritative sources.

Mei, Kaling, Xinyi, Sing, and Khoon (2007) explored the efficiency of "Science Alive" a curriculum innovation programme for developing competency in Science Process Skills and the relevance of science in everyday life for the students in the stage of secondary. This intervention covers four modules from the subjects, physics, chemistry and biology. The sample of the study consists of 147 secondary students. Study followed a pre-post survey design. Data analysis indicated that "Science Alive" programme increased the competency in Science Process Skills and perception about the relevance of science in their life.

Monhardt and Monhardt (2006) suggested the use of picture books for teaching the basic and advanced level Process Skills in elementary education in meaningful context. As a starting point, here the researcher used different type of picture books which are appropriate for teaching skills like Observation, classification, communication, inference, measuring and predicting are shown as an example. Researcher concluded that wide variety of children's' literature can be effectively linked with classroom learning and the elementary school teachers can practice these for developing and fostering Process Skills of their students in meaningful way.

Rambuda and Fraser (2004) analysed the perception of secondary school teachers of the application of Science Process Skills for the geography teaching in Free State province of South Africa. The sample of the study consists of 150 secondary school teachers. To know the perception a questionnaire was constructed and content validated against theoretical assumptions and literature of process skill. The responses were analysed by the factor analysis and varimax method of rotation. Two important factors were identified, 1. Simple basic Science Process Skills and 2. Higher level integrated process skills.

Ngoh (2000) examined the mastery of Science Process Skills through teaching a course unit "thinking and working scientifically" for students teachers studying in the primary science education programme conducted by teacher education institute of Malaysia. The study was conducted by one group pre-test post-test experimental design. A total of 56 student teachers enrolled in the course unit were taught the content and application of Science Process Skills from January to May 2008 through a variety of lectures and hands on activities. Data was collected by using the test of process skill knowledge, which consists of 25 items for representing both basic and integrated process skills. Analysis of test responses shows that 38 student teachers shows an increase of test score between 1 and 7, 10 student teachers show a decrease of score between 1 and 5 and 8 shows no change in the pre-test and post test respectively. The study concluded that some of the student teachers learned the process skills as a result of course, however none of the student secured a perfect score in per-test and post-test indicates that they are familiar with some of the given Science Process Skills.

Conclusion

An intense search of related studies magnified that a series of studies are conducted on variables namely Metacognition, Goal Orientation, Learning Styles and Science Process Skills. The researcher analysed different studies conducted from 2000 onwards. However, the studies which are highly relevant and suitable to the present context are only presented in the review of literature. From the review, it is clear that most of the studies on the selected variables are conducted in European and American countries. Number of studies conducted by Indian scholars on the above variables are found to be very limited and few in number.

From the review studies the investigator made it clear that there are numerous studies related with SPS. Science Process Skills help every learner to construct their own knowledge by means of scientific inquiry. When the students are able to understand what science is and how it actually works, then they should necessarily make use of their science process skills as well as scientific content knowledge compulsory to be learned in any science curriculum. Science curriculum based on scientific literacy have been reoriented at times and aimed at providing students with a deeper understanding of science process skills and make them fully competent to deal with scientific process as far as possible. The investigator noticed that most of the studies on Science Process Skills addressed the necessity for improving SPS of both students and teachers through various practices, methods and strategies within content knowledge. Hence it is obvious to conclude that science teaching and learning without science process skills make the scientific world unreal embedded with myths and fallacies.

Metacognitive Awareness is important to foster construction of new knowledge and for regulating and monitoring the cognition which will contribute to the creation of a supportive environment for promoting academic motivation, academic achievement, academic self-concept etc. Knowledge of parents, teachers and administrators about Metacognitive Awareness and it is helpful to understand how the problematic and unsuccessful students show undesirable behaviours. Hence the review of related literature in the area of Metacognitive Awareness acquainted the researcher with the current progress and position of the study.

Literature is enough to show that students' goal orientation is a powerful variable in educational field. In the early stages of 20^{th} century and it gained a central role in the theoretical framework of academic motivation. Goal Orientations offered educators a number of practical implications for classrooms since educators think more critically about the types of goals that teachers and schools foster in their students, they may be better able to shape the motivational patterns adopted by children and adolescents in school settings.

Review regarding Learning Styles show that existing literature is rich with different learning theories, different learning/cognitive styles and its implications. All of these researchers elicit one common fact that individuals learn differently and it would be a valid point for teachers to teach different kinds of learners differently. Hence the assessment of Learning Styles and its effect on different outcomes is highly important to stakeholders of education since the learning styles may affect individuals' way of thinking in every moment of the life. Thus, this result has a significant part in education for making teaching-learning activities effective.

From all the studies it is clear that Metacognitive Awareness, Goal Orientation and Learning Styles are significant predictors of different outcomes like academic performance, problem solving skill, self efficacy and other relevant cognitive and socio-affective variables. Available studies shows extreme inadequacy in related studies on metacognition, Goal Orientation and Process Skills in India and there by suggests the scope of further investigation to study learning achievement in science of secondary school students in relation to these variables and science outcomes. Hence the investigator perceived that there is a need to identify the influence of Metacognitive Awareness, Goal Orientation and Learning Styles on Process Skills in Chemistry.

CHAPTER 3

Methodology

- *Variables of the Study*
- *Objectives of the Study*
- *Hypotheses of the Study*
- *Method Used for the Study*
- *Sample Selected for the Study*
- *Tools Used for Data Collection*
- *Data Collection Procedure*
- *Statistical Technique Used*

Research methodology is a systematic and scientific attempt to solve a problem under consideration and it should be emerged out of detailed review of literature. It is very essential and success of any research work depends upon the methods, tools and techniques of analysis employed for the study. The investigator has adopted 'Survey Method' for the study by considering its relevance and feasibility.

The present study is an attempt to find out the influence of three Predictor Variables namely; Metacognitive Awareness, Goal Orientation and Learning Styles on the Criterion Variables; Basic and Integrated Process Skills in Chemistry of Secondary School Students. In the first phase, the study was focussed to find out the extent of Predictor Variables; Metacognitive Awareness, Goal Orientation and Learning Styles and in the second phase, the study was aimed to identify the significant differences in the Predictor Variables; Metacognitive Awareness, Goal Orientation and Learning Styles and the Criterion Variables, Basic and Integrated Process Skills in Chemistry on the basis of sub samples Gender, Locale and Type of Management of Institution. The third phase of the study was focussed to identify the significant predictors and their relative efficiency in predicting the Criterion Variables, Basic and Integrated Process Skills in Chemistry of Secondary School Students.

This chapter presents a systematic frame work of the study followed by the researcher during the conduct of the study. The methodology adopted for the present study is described under the following headings.

Variables of the Study

Objectives of the Study

Hypotheses of the Study

Method used for the Study

Tools Used for Data Collection

Sample Selected for the Study

Data Collection Procedure

Statistical Technique Used

Variables of the Study

Variables selected for the study includes Metacognitive Awareness, Goal Orientation and Learning Styles as Predictor Variables and Basic and Integrated Process Skills in Chemistry as Criterion Variables.

Rationale for Selecting the Predictor Variables

The Predictor Variables of the study were selected after conducting a thorough review of literature in the area of academic performance in science. The literature shows that the academic performances of students are influenced by a number of factors which can be broadly categorised as personal (cognitive, affective and psychomotor), instructional and environmental (social and familial) etc. In the present study, the selection of a Predictor Variable was based on the assumption that:

i. The variables might be related and should be the effective predictors of Science Process Skills.

ii. The selected factors have strong theoretical foundation and can be objectively measured.

iii. The influence of effect of Metacognitive Awareness, Goal orientation and Learning Styles on achievement in different subjects is already established but their cross over effects on other outcomes of learning is not studied so far and it should be studied.

Extensive review of literature minimised the effort to locate the prime variables which exert influence on Process Skills in Science. Such variables were classified and presented as follows.

Cognitive Variables.

Cognition, metacognition, intelligence, spatial abilities, critical thinking, reasoning, comprehension and numerical abilities etc. are included in this category. All these are included under cognitive domain. The power of these variables either singly or in combination in determining acquisition of Science Process Skills is not so much reported.

Affective Variables.

This category includes non – cognitive variables like personal characteristics, attitudes, interest, achievement motivation, adjustment, anxiety, extroversion and introversion etc. Research evidences are not enough to reflect the relationship between these variables and Science Process Skills.

Instructional Factors.

Variables like study habits, approaches to learning, Learning Styles, method of teaching, instructional effectiveness, evaluation procedures, classroom climate, use of audio – visual aids and text books, size of class, co-curricular activities and influence of teachers etc are included in this category. The literature studies show that this topic is not widely studied in correlation with Science Process Skills.

Environmental Factors.

This includes parental education, profession and income, previous educational and social experiences, locale, facilities available at home, family integration and approval by the family members, social responsiveness and commitment etc.

Hence the identification of wide array of factors affecting student's process skills in Chemistry lead the investigator to make a cautious selection of variables for the present study. Among the different factors the investigators selected Metacognitive Awareness, Goal Orientation and Learning Styles as Predictor Variables.

The researcher noticed several studies in the field of Metacognition and Achievement (Hartman, 2001; Wilson, 1999; Hacker, Dunlosky & Graesser, 1998; Jacobs & Paris, 1987; Schoenfeld, 1992). In the field of Achievement Goal Theory, the researcher identified variety of studies related with several indicators of academic performance (Ames, 1992; Cetin & Akin, 2009; Murayama & Elliot, 2009; Kaplan, Middleton, Urdan & Midgley, 2002; Elliot & Church, 1997; Skaalvik, 1997). Also the researcher experienced that if the students are intrinsically motivated towards a goal they will be more persevering, motivated and competent. In addition to this many researchers studied the Learning Style preferences and how it is related to achievement of students (Dasari, 2006; Claxton, 1990; Pheiffer, Holley & Andrew, 2005). Apart from these, if the teacher is able to provide instruction based upon students' learning styles; students can easily attain the above qualities. Recent studies in science education show that achievement in science can be enhanced by coordinating cognition and motivation.

Based on different studies and findings, the investigator could identify that Metacognitive Awareness, Goal Orientation and Learning Styles are the predominant factors in affecting Basic and Integrated Process Skills in Chemistry. Therefore the researcher hypothesised that a learner having Cognitive understanding of oneself, with a pre-determined goal towards a task and a suitable style of learning will be able to make learning process more productive, transferable and long lasting.

By considering the above criteria, the Predictor Variables, Criterion Variables and Classificatory Variables selected for the study are the following:

Predictor Variables

The Predictor Variables selected for the study consist of Metacognitive Awareness, Goal Orientation and Learning Styles. To convey the specific meaning of the selected Predictor Variables, an attempt has been made by the investigator to explain in what sense these terms and concepts have been used in the present study.

Metacognitive Awareness.

Metacognitive Awareness is the individual's beliefs about oneself and about others as learners and of the requirements involved in the learning process related to metacognitive knowledge acquired through both conscious and unconscious means, and in formal and informal settings (Flavell, 1979).

For the present study Metacognitive Awareness is defined as learners' awareness/self assessment about how they (1) prepare and plan for learning, (2) select and uses various learning strategies, and (3) monitor and evaluates the strategy used for learning. In the study, the score obtained in the 'Scale of Metacognitive Awareness' administered on the selected sample of Secondary School Students is considered as Metacognitive Awareness.

Goal Orientation.

Goal Orientation refers to the relevant purposes or aims that individual strive for in achievement settings, and these different purposes or aims are posited to lead to differential performance outcomes (Elliot, Shell, Henry & Maier, 2005).

For the present study Goal Orientation is defined in terms of certain achievement goals; Viz Mastery, Performance–Approach and Performance-Avoidance Goals which individual adopts in the learning process and these lead to differential performance outcomes. In the study, the scores obtained in the 'Scale of Goal Orientation' administered on the selected sample of Secondary School Students are considered as Goal

Orientation. Three main types of Goal Orientation used in the present study are as follows;

1) ***Mastery Goal Orientation (MGO)*** refers to students' focus or motivation to increase one's knowledge/mastery of task and their desire to acquire new skills.
2) ***Performance-Approach Goal Orientation (PAPGO)*** refers to students' focus or motivation to perform better than their peers and receiving favourable judgments of ability from others.
3) ***Performance-Avoidance Goal Orientation (PAVGO)*** refers to students' focus on avoiding the perception of incompetence in comparison to others and avoiding unfavourable judgements of abilities from others.

Learning Styles.

Learning Styles is the composite of characteristics cognitive, affective and psychological factors that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment (Keefe, 1997).

For the present study, Learning Styles is defined in terms of Visual, Auditory and Kinesthetic ways of learning preferred by students for accommodating their needs in the teaching - learning process. The scores obtained in the 'Learning Style Inventory' administered on the selected sample of Secondary School Students are considered in this study. Three main types of Learning Styles used in the present study are as follows;

1) ***Visual Learning Style (VLS)*** is a mode of learning with the use of seen or observed things including pictures, diagrams, demonstrations, displays, handouts, films, charts, maps and circles etc. These learners gain and retain information by seeing it.

2) ***Auditory Learning Style (ALS)*** is a mode of learning through listening: to the spoken word, of self or others, of sounds and noises. They learn best from lectures, radio, group discussions etc.

3) ***Kinesthetic Learning Style (KLS)*** is a mode of learning by involving physical experience - touching, feeling, holding, doing and practical hands-on experiences. These learners are more connected to reality either through concrete personal experiences and practice or simulation.

Rationale for Selecting the Criterion Variables

Science is a human endeavour through which biological and physical changes of surrounding world can be understood. Science is built in an environment composed of different process like experiences, inquiry, analysis and discovery etc. The success and development of a nation is indicated by outcomes of scientific activities and the number of scientists who are capable of solving issues related to environment, health and poverty etc. So, the performance of students in science related activities must be assessed and improved for the betterment of the society. Even though science is a very interesting subject it covers wide scope of doing experiments and investigations through systematic discovery process.

Science curriculum, especially at the secondary level, demands integrated way of learning which culminates the knowledge, skills and attitudes in all domains of an individual. In India, NCERT and NCF (2005) recommend that "Process Approach" in science is the one of the core elements of the integrated curriculum at the secondary level. Teaching of science through process oriented approach helps to develop inquisitiveness and scientific curiosity among learners (Turpin, 2000).

The teaching and learning of science is a tedious effort for teachers as well as for learners and is not yet reached to a satisfactory limit besides the development and changes in curriculum, instructional strategies and evaluation methods. Majority of the teachers present facts and concepts of science as described by the reference materials and other available sources rather than providing lively experiences (Aktamis & Ergin, 2008). Because of this, students fail to establish a connection between what they taught in the class and how to apply these in their daily life events. So one of the major concerns of the investigator was the improvement of performance in science, especially among secondary schools students. For achieving this, the investigator initially analysed variables that are related to academic performance in science. During this stage the investigator identified that Science Process Skill is an important outcome and a suitable achievement in the field of science.

The investigator reviewed and scrutinised a wide spectrum of related researches in this area conducted internationally and nationally in detail. Considering the importance of process aspects of science, almost all national level documents (Kothari Commission, 1964-66; NPE, 1986; NCF, 2000, 2005) recommended that process skills in science is an integral part of science education, and developing process skill is one of the objectives of science teaching. Also, various policies like Physical Science Study Curriculum (PSSC), Science: A Process Approach (SAPA), Harvard Physics Project (HPP), Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS), Elementary School Science Curriculum Improvement Study (ESSP), School Science Curriculum Project (SSCP), Minnesota Mathematics and Science Teaching Project (MINNEMAST), Chemical Education Material Study (CHEMSTUDY), Chemical Bond Approach (CBA), and Nuffield courses in the UK stresses on process skills through different approaches such as inquiry approach, investigatory approach, and discovery approach of teaching science. For improving science teaching, they advocate that there should be a shift from listening science to doing science in schools (Rezba, Sprague & Fiel, 2003). This can be accomplished through process oriented teaching and the product of this will be the development of process skills. Once the learners are carried through this systematic procedure, it is easy to accommodate scientific facts.

Among different science subjects, the researcher was solely interested in the subject of Chemistry and had experienced the difficulties due to the absence of even lower level skills for understanding the facts and principles of Chemistry. Hence the investigator selected Process Skills in Chemistry of secondary school students as the Criterion Variable for the study.

Criterion Variables

The main Criterion Variable selected for the study was Process Skills in Chemistry of Secondary School Students. In the present study the Process Skills in Chemistry is divided in to two levels such as Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry and treated as separate Criterion Variables.

Process Skills in Chemistry.

Process Skills in Chemistry are defined as a set of skills that are reflective of the behaviour of scientists, are appropriate to many science disciplines, and are abilities that are broadly transferable to other situations (Padilla, 1990). In the present study, Process Skills in Chemistry can be defined in terms of a set of Basic and Integrated Skills appropriate to the branch of Chemistry.

Basic Process Skills in Chemistry (BPS).

Basic Process Skills in Chemistry can be defined in terms of a set of Basic Process Skills such as Observing, Classifying, Communicating, Measuring, Predicting, Using Number Relations and Inferring which are identified in the subject of Chemistry. The scores obtained in the 'Test of Basic Process Skills in Chemistry' administered on the selected sample of Secondary School Students are considered in this study.

Integrated Process Skills in Chemistry (IPS).

Integrated Process Skills in Chemistry can be defined in terms of a set of Integrated Process Skills such as Formulating Hypotheses, Controlling

Variables, Interpreting Data, Analyzing and Generalizing which are identified in the subject of Chemistry. The scores obtained in the 'Test of Integrated Process Skills in Chemistry' administered on the selected sample of Secondary School Students are considered in this study.

Classificatory Variables

The variables like Gender of Students (Male and Female), Locality of the Institution (Rural and Urban) and Type of Management of the Institution (Government and Aided) are treated as classificatory variables for the study.

Objectives of the Study

This study intends to assess the level of selected Predictor Variables and Criterion Variables for Secondary School Students. The study examined the influence of selected Predictor Variables namely, Metacognitive Awareness, Goal Orientation and Learning Styles on Process Skills in Chemistry of Secondary School Students.

In order to accomplish the major objective, the study has the following specific objectives.

1. To find out the level of Metacognitive Awareness among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
2. To find out the extent of Goal Orientation among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

3. To find out the Learning Style Preferences of Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

4. To study whether there exist any significant differences in the mean scores of Metacognitive Awareness and its Levels between the subsamples based on Gender, Locale and Type of Management of the Institution.

5. To study whether there exist any significant differences in the mean scores of Mastery Goal Orientation (MGO), Performance- Approach Goal Orientation (PAPGO) and Performance- Avoidance Goal Orientation (PAVGO) between the subsamples based on Gender, Locale and Type of Management of the Institution.

6. To study whether there exist any significant differences in the mean scores of Visual Learning Style (VLS), Auditory Learning Style (ALS) and Kinesthetic Learning Style (KLS) between the subsamples based on Gender, Locale and Type of Management of the Institution.

7. To study whether there exist any significant differences in the mean scores of Basic Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

8. To study whether there exist any significant differences in the mean scores of Integrated Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

9. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

   (ii) To estimate the Multiple Correlation (R) between significant predictors and the Criterion Variable, Basic Process Skills in Chemistry.

   (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Basic Process Skills in Chemistry for the Total sample and subsamples based on Gender, Locale and Type of Management the Institution.

10. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

   (ii) To estimate the Multiple Correlation (R) between significant predictors and the Criterion Variable; Integrated Process Skills in Chemistry.

   (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Integrated Process Skills in Chemistry for the Total sample and the subsamples based on Gender, Locale and Type of Management the Institution.

Hypotheses of the Study

Hypotheses provide a clear path to the investigator and delimit the study into some relevant issues of the problem under consideration.

The present study is designed to have testing of the following hypotheses:

1. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Gender.
2. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Locale of the Institution.
3. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Type of Management of the Institution.
4. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Gender.
5. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Locale of the Institution.

6. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Type of Management of the Institution.

7. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Gender.

8. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Locale of the Institution.

9. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Type of Management of the Institution.

10. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Gender.

11. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Locale of the Institution.

12. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Type of Management of the Institution.

13. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Gender.

14. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Locale of the Institution.

15. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry for the sub samples based on Type of Management of the Institution.

16. Metacognitive Awareness, Goal Orientation and Learning Styles will be the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

17. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

18. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Basic Process Skills in Chemistry for the Total sample and the subsample based on Gender, Locale and Type of Management of the Institution.

19. Metacognitive Awareness, Goal Orientation and Learning Styles will be significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

20. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

21. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Integrated Process Skills in Chemistry for Total sample and subsample based on Gender, Locale and Type of Management of the Institution.

Method Used for the Study

The present study is an attempt to investigate the Basic and Integrated Process Skills in Chemistry of Secondary School Students of Kerala in relation to their Metacognitive Awareness, Goal Orientation and Learning Styles. Considering the nature of the problem under investigation and nature of data required for study, it was decided to adopt Survey as the method for collection of data. In research methodology survey method is widely used to study the characteristics of population through a systematic procedure. During collection of data due weightage was given to Gender of students, Locality of the Institution and Type of Management of the Institution.

Tools Used for Data Collection

The selection of a suitable tool is of vital importance for successful research. Only an accurate and reliable tool can supply the correct data which is inevitable for a valid study. For the present study, the investigator used five tools which were constructed and validated by the investigator in consultation with supervising teacher. Tools used for the present study are the following:

1. Scale of Metacognitive Awareness
2. Scale of Goal Orientation
3. Learning Styles Inventory
4. Test of Basic Process Skills in Chemistry
5. Test of Integrated Process Skills in Chemistry

Scale of Metacognitive Awareness - SMA (Hameed, Meharunnisa & Sabna, 2014)

This scale is intended to assess the Metacognitive Awareness of Secondary School Students. Metacognitive Awareness is an important element of Metacognition, which is a cognitive construct making the individual conscious about oneself. This scale includes items on awareness regarding various stages and process executed and followed by the students while carrying learning tasks and activities.

Description of the various stages in the development of the Scale of Metacognitive Awareness is presented as follows.

Planning.

Metacognitive Awareness Inventory is constructed and standardised by the investigator in consultation with the supervising teacher. Theory of Metacognition proposed by Flavell (1979), Brown (1987), Anderson (1991), and the Metacognitive Awareness Inventory developed by Schraw & Dennison (1998) are considered as the major sources for preparing this Scale. For constructing this tool, the investigator reviewed theoretical and empirical studies in the field of educational researches, sought description of Metacognitive Awareness inventories in prior research areas in educational field and observed personally several students while engaging in learning related activities. In addition to this, personal contact with secondary school teachers, opinions of educational experts, psychologists and researchers in the field of education and extensive review of literature are the sources for developing items for the study. Most of the tools available in the existing literature are found to be used for measuring metacognitive perception in a general way and was not focussed on Metacognitive Awareness in Science learning. So the investigator decided to construct a new instrument for assessing the Metacognitive Awareness particularly for Secondary School Science class.

Preparation.

The first step in the development of Metacognitive Awareness Inventory was the identification of tentative list of the dimensions of Metacognitive Awareness. For the present study the Flavell's model of

Metacognition was used. Flavell (1979) divided the concept of Metacognition in to two parts:

- Metacognitive Knowledge/ Awareness and
- Metacognitive Regulation.

Metacognitive knowledge/Awareness.

Knowledge of cognition or metacognitive knowledge refers to knowledge about self and about learning strategies as well as knowledge about when, why and how to use these learning strategies. Within the knowledge component the statements of knowledge about self and strategies, knowledge about other cognitive constructs like interest, attention, memory etc are included. The three stages included in this dimension and its characteristics are given in the following part.

Knowledge of self (declarative knowledge).

Knowledge of Self is concerned with an individual's conscious awareness regarding personal skills and all other intellectual resources related to learning. The sub components are the following:

- Awareness of personal strengths and weaknesses
- Awareness of other intellectual abilities like Interest, Attention, memory etc.

Example.

I am aware of the various elements which creates interest in learning

Preparation and planning for learning (procedural knowledge).

This area consists of awareness regarding major metacognitive and cognitive activities at the initial planning stage of learning and they are able to think upon what, how and why they need to accomplish a particular task. The sub components are the following:

- Goal setting toward a particular task
- Previous Knowledge
- Sequential ordering of the task
- Time requirements

Example.

I always make use of previous knowledge suitably during learning situations.

Conditional knowledge.

Conditional knowledge refers to knowing when and why to use declarative and procedural knowledge (Garner, 1990). For example, effective learners know when and what information to rehearse. Conditional knowledge is important because it helps students selectively allocate their resources and use strategies more effectively. Conditional knowledge also enables students to adjust to the changing situational demands of each learning task. It includes;

- Transfer of learning under suitable circumstances
- Knowledge about *when* and *why* to use learning procedures

- Application of declarative and procedural knowledge with certain conditions presented

Example.

I am able to apply already learned things while studying new materials.

Metacognitive regulation.

The second component of Metacognition is regulation of cognition. It refers to the monitoring and control of one's cognitive processes during learning (Nelson & Narens, 1990). The three stages included in this dimension and its characteristics are given in the following part.

Selecting and using learning strategies.

This stage is concerned with individual's awareness regarding identification, selection and use of a particular strategy with a specific purpose which helps learners to think and take decision about the learning process, which include:

- Identification of strategies
- Find out difficulties for using strategies
- Use of a particular strategy with a specific purpose

Example.

I used to find out most suitable methods to learn different subjects.

Monitoring and evaluating strategy use.

When students have selected and started to work on particular strategies they need to ask themselves frequently; is the strategy sufficient or not? What strategies am I using? It also include knowledge of how to orchestrate i.e. coordinate and make associations between the various strategies and can carry over the positive outcomes in another situation.

- Is it in accordance with our pace and style?
- Identification of errors in the present method
- Modifications in strategies for improvement
- Use of multiple strategies and association of strategies

Example.

I know when and where to use a particular learning strategy on the basis of its effectiveness.

Evaluation of self.

In this area they are concerned about 1) what am I trying to achieve? (2) In what way can I change my decisions? (3) How well am I using them? (4) What else could I do? Responses to these questions integrate all of the previous aspects of metacognition, including self assessment which allows the learner to reflect through the cycle of learning. It includes;

- Evaluation of goal
- Assessing the suitability of procedures
- Verifying results obtained

Example

I utilize all the available occasions to evaluate my demerits in learning.

Writing of items.

While writing items, careful attention was sought to ensure that each item is measuring only the dimension covered by its prior assigned inventory. The investigator prepared positive and negative items for the above six components of the Metacognitive Awareness and the draft tool was prepared with the help of supervising teacher. Then the investigator discussed with the supervising teacher on ensuring the relevance of each statement prepared, and to remove its ambiguity in its wording. After a thorough scrutiny and editing, the final form of draft scale was made. The final version of draft consists of 66 items and was constructed based on all components and the items were arranged randomly. The component wise item numbers are presented in the following section.

Table 1

Component wise Item Details of the Scale of Metacognitive Awareness

Components	Item numbers	No. of Items
Knowledge of Self	1,2,7, 14, 16, 34, 36, 41, 62, 66	10
Preparation and planning for learning	8, 15, 19, 25, 27, 36, 42, 44, 46, 54, 58	11
Conditional Knowledge	5, 6, 26, 28, 31, 43, 49, 52, 53, 65	10
Selecting and using learning strategies	3, 9, 11, 17, 22, 39, 40, 45, 50, 57, 63, 64	12
Monitoring and evaluating strategies	10, 12, 21, 23, 24, 35, 37, 38, 47, 48, 55, 61	12
Evaluating of self	4, 13, 18, 20, 30, 32, 33, 51, 56, 59, 60	11
Total		66

Pilot testing.

The draft scale was administered to a representative group of 400 Secondary School Students giving due weightage to sub samples and response sheets were collected. Incomplete response sheets are discarded.

After random rejection the sample was fixed to 370. The responses of each item by all secondary school students in the sample were scored and subjected to item analysis. The draft version of the Scale of Metacognitive Awareness in Malayalam and its English version are presented as Appendices A1 and A2 respectively.

Item analysis.

For the finalisation of the items in the inventory, certain procedure suggested by Likert (1932) is used. The responses collected from 370 students were arranged in the descending order based on score obtained. Then the subjects were grouped as high group and low group respectively. The top 27% students and bottom 27% students were taken as the high group and low group respectively for item analysis. The number of students in lower and upper group was 100 each. The mean and standard deviation of each item were calculated separately for lower and upper groups and t-value were calculated. Items having the t-value above 2.58 were selected for the final version of Metacognitive Awareness Inventory. The final version of Inventory consists of 53 items. The t-value for each item was calculated using the formula (Formula 1)

$$t = \frac{\overline{X}H - \overline{X}L}{\sqrt{\frac{\sigma_H^2}{N_H} + \frac{\sigma_L^2}{N_L}}}$$

Where

$\overline{X}H$ = mean of each item in upper group

$\overline{X}L$ = mean of each item in lower group

N = number of students in upper lower groups

σ^2_H = The variance of the distribution of the response of the upper group to the students.

σ^2_L = The variance of the distribution of the response of the lower group to the students.

N_H = The number of the subject in the upper group

N_L = The number of the subject in the lower group

The t-value of each item are presented in Table 2.

Table 2

Data and Results of Item Analysis of Scale of Metacognitive Awareness

Item No	t values	Status	Item No	t values	Status	Item No	t values	Status
1	2.83	Accepted	23	3.54	Accepted	45	4.16	Accepted
2	2.37	Rejected	24	6.99	Accepted	46	5.28	Accepted
3	3.35	Accepted	25	7.40	Accepted	47	3.30	Accepted
4	3.36	Accepted	26	3.07	Accepted	48	0.63	Rejected
5	4.31	Accepted	27	2.39	Rejected	49	5.23	Accepted
6	3.45	Accepted	28	3.21	Accepted	50	3.84	Accepted
7	4.42	Accepted	29	4.67	Accepted	51	4.81	Accepted
8	1.99	Rejected	30	3.58	Accepted	52	2.12	Rejected
9	4.21	Accepted	31	6.20	Accepted	53	5.27	Accepted
10	4.72	Accepted	32	3.64	Accepted	54	4.16	Accepted
11	3.74	Accepted	33	6.78	Accepted	55	4.78	Accepted
12	2.88	Accepted	34	3.13	Accepted	56	5.57	Accepted
13	2.80	Accepted	35	1.97	Rejected	57	3.35	Accepted
14	4.05	Accepted	36	5.67	Accepted	58	4.70	Accepted
15	3.61	Accepted	37	4.96	Accepted	59	5.47	Accepted
16	4.79	Accepted	38	3.24	Accepted	60	2.55	Rejected
17	0.66	Rejected	39	2.51	Rejected	61	3.61	Accepted
18	3.78	Accepted	40	2.47	Rejected	62	2.52	Rejected
19	3.48	Accepted	41	2.85	Accepted	63	2.95	Accepted
20	2.56	Rejected	42	4.53	Accepted	64	4.58	Accepted
21	4.84	Accepted	43	2.36	Rejected	65	5.46	Accepted
22	4.15	Accepted	44	4.81	Accepted	66	6.21	Accepted

Scoring procedure.

The final inventory consists of 53 items in which 35 are positive and 18 are negative. The responses are collected on a three point likert scale as 'Always', 'Sometimes' and 'Never' and scored as 3, 2, 1 for positive items and 1, 2, 3 for the negative items. All the item score for each student are to be summated to obtain a total measure of the Metacognitive Awareness.

Establishing validity and reliability.

The validity and reliability of the tool was established by the following method.

Validity.

The most important quality of a tool is its ability to measure what it intends to measure. According to Best and Kahn (1975) "The validity is the quality of a measuring instrument or procedure that enables to determine what it was designed to determine". It tells how well an empirical indicator and the conceptual definition of the construct that the indicator is supposed to measure "fit" together (Newman, 2006). Initially the validity of the instrument was established by Face Validity and Construct validity.

Face validity.

If one can look at an instrument and understand what is being measured, it has face validity (Patton, 1997). To test the face validity, the executives of the firm should evaluate the instrument first, to make sure the instrument is evaluating what they want to know (Patton, 1997). The tool has face validity according to the judgement by a group of experts in this field and the statements in the scale appear to measure the Metacognitive Awareness of Secondary Schools Students.

Construct validity.

Construct validity is important in psychological research especially when the construct is not directly observable. It is the extent to which the operational variable used in a study is a good approximation of the conceptual variable. Construct validity of the tool was subjectively assured by the investigator by understanding the consistency in the multiple indicators of the construct 'Metacognition' and the underlying conceptual boundaries of the construct are clearly specified under various dimensions of the instrument.

Criterion validity.

This method uses some standard or criterion to indicate a construct accurately. For establishing this the investigator used the scores obtained for a group of 40 secondary school students correlated with Junior Metacognitive Awareness inventory (Sperling, Howard, Miller & Murphy, 2001), which is a 5 point scale to measure the Metacognitive Awareness of Secondary School Students. The correlation between the scores of the two inventories was found out using Pearson's Product Moment Coefficient of Correlation. The coefficient of validity obtained was found to be 0.68. This index shows that the inventory is a valid one for the study.

Reliability.

According to Burns (1997) "Reliability is the extent to which or accuracy with which a test measures what it has been constructed to measure". Reliability measures provide an estimate of how much variation we might expect under different conditions. The investigator used Test-Retest Method to find out the reliability of the test. For determining the Test-Retest Reliability the investigator selected 40 students who attempted the inventory for the first time. The inventory was again administered to that group after three weeks time. Then the two scores were correlated to find out the reliability coefficient and the reliability coefficient was found to be 0.84. The Cronbach's alpha obtained for the scale of Metacognitive Awareness is 0.87. Hence the Scale of Metacognitive Awareness is a valid and reliable tool with good psychometric properties to assess the Metacognitive Awareness of Secondary School Students

Final version of the tool in Malayalam and English languages are presented as Appendices A3 and A4 respectively.

Scale of Goal Orientation - SGO (Hameed & Meharunnisa, 2014)

This Scale of Goal Orientation (SGO) was used to find out the type of goals adopted by Secondary School Students in achievement situations. The concept of Goal Orientation is emanated from the research conducted by Dweck and her colleagues (1986). The original work conducted by Dweck and her colleagues implied that individual tend to adopt either a learning or performance goals in achievement situations (Dweck, 1986). That is individuals either strive to develop their skills, knowledge, expertise or attempted to demonstrate their competence and outperform specific targets, standards or competitors.

Description of the various stages in the development of the Scale of Goal Orientation is presented as follows.

Planning.

Scale of Goal Orientation is constructed and standardised by the investigator in consultation with supervising teacher. This scale has been developed on the basis of Achievement Goal Theories of Dweck (1986); Ames (1992) and Pintrich (2000). Achievement Goal Orientation Questionnaire (Roedel, Schraw & Plake, 1994), Achievement Goal Orientation Questionnaire (Elliot and Mc Gregor, 2001), Achievement Goal Orientation Scale (Akin, 2012), and Goal Orientation Questionnaire (Elliot & Church, 1997) are the major tools available to measure the goal orientation. All the tools in the existing literature are found to be used for measuring goal orientation for all samples and it is not exclusively for measuring Secondary School Students' achievement goals. Hence the investigator pooled all the available tools and decided to construct a new tool for measuring the Achievement Goal Orientation of Secondary School Students while they are engaging in learning tasks. In addition to this, personal contact with secondary school teachers, educational experts, researchers in the field of education and extensive review of literature are the sources for developing the items for the tool.

Preparation.

The first step in the development of the Scale of Goal Orientation was the identification of a tentative list of dimensions of Goal Orientation. For this the investigator has gone through the available literatures related to Goal Orientation and selected the Elliot's classification (1999) as the basis. The scale consists of three sections which represents the items covering Mastery, Performance-Approach and performance-Avoidance Goal Orientations. Description of each component with example are given in the following section

Mastery Goal Orientation (MGO).

"Mastery goal is a personal intention to improve abilities and learn no matter performance suffers" (Ames, 1992). A person who sets mastery goal tries to improve, to learn, to challenge and no matter how awkward they appear. The features of this component are following:

- Focussed on mastery of the task, learning and deep understanding concepts
- Use of standards for self improvement and progress, not bothered about grades
- Seeking challenges
- Attainment of competence

- High degree of perseverance
- Persist when they encounter difficulties
- Help seeking and use cognitive processing strategies for learning
- Use and apply better study strategies and approach academic tasks with confidence

Example.

I like lessons that provide new knowledge even though they are challenging.

Performance Goal Orientation (PGO).

"Performance goal is a personal intention to seem competent or perform well in the eyes of others" (Elliot, 1996). Students with performance goal care about demonstrating their abilities to others. They may be focussing on getting good test scores and grades, or they may have concern of winning other students. Subsequently, performance orientation was subdivided in to two facts:

Performance-Approach Orientation (PAPGO).

The features of the performance-approach goal orientations are;

- Focused on being superior, winning and being the best
- They use standards of normative, getting highest grades and winning the competition
- Avoidance of incompetence and failure
- Use of normative standards such as getting best or highest grades
- Intrinsic motivation is low

Example.

I am unable to give importance to learning when it is not evaluated.

Performances-Avoidance Orientation (PAVGO).

The features of performance-avoidance orientations are following:

- Focused on avoiding looking stupid and avoiding losing
- They may use standards of normative don't be the worst, get the lowest grade or be the slowest.
- Use of normative standards of not getting the worst grades, being the worst performer in the class
- Avoid losing
- High anxiety and self handicapping

Example.

I don't usually take up activities that may cause failure or that may push me downwards.

Writing of items.

It was decided to measure the Achievement Goal Orientation of Secondary School Students using a scale. While writing items, careful attention was made to ensure that each item measures only one of the three components and their features mentioned above. The investigator prepared positive and negative items for the above three components of the Goal Orientation and the draft tool was prepared with the help of the supervising teacher. Then the investigator discussed with the supervising teacher on ensuring the relevance of each statement prepared, and to remove its ambiguity in the structure of words. After a thorough scrutiny and editing, the final form of draft scale was made. The final version of the draft test consisted of 61 items based on three types of Goal Orientation and the items were arranged 1 to 61 under three sections in such a way that the first 27 items were meant to measure Mastery Goal Orientation, the next 17 items meant to measure Performance-Approach Goal Orientation and the last 17 items meant to measure Performance-Avoidance Goal Orientation. The section wise item numbers are presented in Table 3.

Table 3

Section Wise Item Details of Scale of Goal Orientation

Goal Orientation	Item Numbers
Mastery Goal Orientation	1 to 27
Performance - Approach Orientation	28 to 44
Performance - Avoidance Orientation	45 to 61

Pilot testing.

The draft scale was administered to a representative group of 400 Secondary School Students with due weightage to sub samples. On completion of the pilot test, incomplete response sheets were discarded. After random rejection the sample was fixed to 370. The responses of each item by all Secondary School Students in the sample were scored and subjected to item analysis. The draft of Scale of Goal Orientation in Malayalam and English are presented as Appendices B1 and B2 respectively.

Item analysis.

For the finalisation of the items in the inventory the procedure suggested by Likert (1932) was used. The responses collected from 370 students were arranged in the descending order based on their score obtained. Then the subjects were grouped as high group and low group respectively. The top 27% students and bottom 27% students were taken as the high group and low group respectively for item analysis. The number of students in lower and upper groups was 100 each. The mean and standard deviation of each item were calculated separately for lower and upper groups and t-value were calculated. Items having the t-value above 1.96 were selected for the final version of Goal Orientation Scale. The final version of scale consists of 39 items. The t-value for each item was calculated using the formula (Formula 1)

$$t = \frac{\overline{X}H - \overline{X}L}{\sqrt{\frac{\sigma_H^2}{N_H} + \frac{\sigma_L^2}{N_L}}}$$

Where

$\overline{X}H$ = mean of each item in upper group

$\overline{X}L$ = mean of each item in lower group

N = number of students in upper lower groups

σ_H^2 = The variance of the distribution of the response of the upper group to the students.

σ_L^2 = The variance of the distribution of the response of the lower group to the students.

N_H = The number of the subject in the upper group

N_L = The number of the subject in the lower group

The t-value of each items are presented in Table 4.

Table 4

Data and Results of Item Analysis for the Scale of Goal Orientation

Item no	t values	Status	Item no	t values	Status
1	5.58	Accepted	32	3.14	Accepted
2	5.67	Accepted	33	2.28	Accepted
3	7.47	Accepted	34	5.93	Accepted
4	1.09	Rejected	35	3.65	Accepted
5	4.96	Accepted	36	2.31	Rejected
6	3.83	Accepted	37	0.32	Rejected
7	1.97	Accepted	38	0.82	Rejected
8	0.00	Rejected	39	1.96	Accepted
9	12.09	Accepted	40	0.85	Rejected
10	13.43	Accepted	41	1.96	Accepted
11	0.91	Rejected	42	2.23	Accepted
12	6.74	Accepted	43	0.56	Rejected
13	3.47	Accepted	44	6.08	Accepted
14	0.39	Rejected	45	1.13	Rejected
15	1.19	Rejected	46	0.29	Rejected
16	1.96	Accepted	47	0.04	Rejected
17	30.17	Accepted	48	1.97	Accepted
18	2.14	Accepted	49	2.19	Accepted
19	3.72	Accepted	50	0.64	Rejected
20	1.18	Rejected	51	0.00	Rejected
21	3.30	Accepted	52	0.12	Rejected
22	1.98	Accepted	53	3.26	Accepted
23	5.10	Accepted	54	2.60	Accepted
24	8.20	Accepted	55	0.94	Rejected
25	3.57	Accepted	56	2.56	Rejected
26	1.14	Rejected	57	2.11	Accepted
27	3.86	Accepted	58	0.53	Rejected
28	3.45	Accepted	59	2.94	Accepted
29	3.02	Accepted	60	1.97	Accepted
30	0.91	Rejected	61	0.19	Rejected
31	1.97	Accepted			

Scoring procedure.

The final Goal Orientation Scale consists of 38 items in which 33 items were positive and 5 were negative. The responses are collected on a five point likert scale as 'Always', 'Often', 'Sometimes', 'Seldom' and 'Never' and scored as 5, 4, 3, 2, 1 for positive items and 1, 2, 3, 4, 5 for negative items. Item wise score of Mastery, Performance-Approach and performance-Avoidance Goal Orientation for a student are to be summated to obtain a total measure of the three type of Goal Orientation of a student.

Validity.

"Validity of a test or any measuring instrument depends upon the fidelity with which a test measures what it purports to measure" (Garette, 1966). It tells how well an empirical indicator and the conceptual definition of the construct that the indicator is supposed to measure "fit" together (Newman, 2006). Initially the validity of the instrument was established by Face Validity and Construct validity.

Face validity.

If one can look at an instrument and understand what is being measured, it has face validity (Patton, 1997). The tool has face validity according to the judgement by a group of experts in this field and the statements in the scale appear to measure the three type of Goal Orientation of Secondary Schools Students.

Construct validity.

Construct validity is "the extent to which the tool measures a theoretical construct or trait or psychological variable". It refers to how well the tool seems to measure or operationalised a hypothesized trait. Construct validity of this tool was subjectively assured by the investigator by understanding the consistency in the multiple indicators of the construct 'Goal Orientation' and the theoretical baseline of the construct, which are clearly specified under different sections of the instrument.

Criterion validity.

For establishing criterion related validity, the scores obtained by a group of 40 secondary school students in the Scale of Goal Orientation were correlated with Goal Orientation Scale (Roedel, Schraw and Plake, 1994), a seven point scale to measure the Achievement Goal orientation of Secondary School Students. The correlation between the scores of the two scales was found out using Pearson's Product Moment Coefficient of Correlation. The coefficients of criterion validity obtained are given in Table 5.

Table 5

Criterion validity Coefficients of Scores Obtained on Scale of Goal Orientation

Sl No	Goal Orientation	Validity Index
1	Mastery Goal Orientation	0.68
2	Performance-Approach Goal Orientation	0.67
3	Performance-Avoidance Goal orientation	0.68

These indices of validity from the Table 5 shows that the scale is valid for the purpose of measuring the Goal Orientation of Secondary School Students.

Reliability.

Reliability measures provide an estimate of how much variation we might expect under different conditions. The investigator used Test-Retest method to find out the reliability of the scale. For determining the Test-Retest reliability the investigator selected 40 students who attempted the inventory for the first time. The inventory was again administered to that group after three weeks time. Then the two scores were correlated to find out reliability coefficient. The obtained reliability coefficients are shown in Table 6.

Table 6

Test-retest Reliability Coefficients of Scores Obtained on the Scale of Goal Orientation

Sl. No.	Goal Orientation	Reliability Coefficient
1	Mastery Goal Orientation	0.74
2	Performance-Approach Goal Orientation	0.73
3	Performance-Avoidance Goal orientation	0.73

Table 6 shows that the Goal Orientation Scale is a reliable tool with good psychometric properties to assess the Goal Orientation of Secondary School Students.

Final version of the scale in Malayalam and English languages were presented as Appendices B3 and B4 respectively.

Learning Styles Inventory- LSI (Hameed & Meharunnisa, 2014)

Learning Styles Inventory is constructed and validated by the investigator in consultation with the supervising teacher. The inventory is intended to investigate the most appropriate mode of learning preferred by Secondary School Students. Learning Style is an important criterion to be identified by teachers in order to accommodate learning needs and for accelerating the effectiveness. Learning Style is specific ways used by a learner or an individual to get information or knowledge which can be obtained in various ways that are deemed as suitable (Slavin, 2006). Various literatures on Learning Styles confirms that learning is effectively taken place only in their preferred Learning Styles and it differs from individual to individual (Buerck, Malmstrom & Peppers, 2003). Butler (1988) suggested that understanding of the characteristics of students is a potential way for improving the course, design and individual learning outcome.

Planning.

For constructing LSI, the investigator firstly reviewed theoretical descriptions and examined different Learning Style models like Kolb's Learning Style Model (1984), Meyers-Brigg Type Indicator (1996), Felder and Silverman Learning Style Model (1988), Grasha- Reichmann's Learning Styles Scale (1982) and Dunn And Dunn Learning Style Model (1996) etc. Depending on the feasibility and applicability in the current educational settings, the investigators decided to develop a Learning Style Inventory on the basis of classification followed by Dunn & Dunn model of Learning Style (1999), Fleming (1992) and Reid (1987). From this, investigators used Visual, Auditory and Kinesthetic mode of categorisation of Learning Style described by Dunn and Dunn (1999). Since Learning Style is highly relevant until the process of learning is existing and the investigators had keen interest for developing a standardised tool, which is more suitable to the sample, the investigator constructed a new tool after referring the available compatible tools in the area.

Preparation.

The first step in the development of Learning Style Inventory was the identification of tentative list of dimensions of Learning Styles. Literature analysis says that there are several ways in which Learning Style models can be categorised. Among these Dunn and Dunn model highlights the importance of senses in perceiving or obtaining information. This style is commonly called as VAK Model of Learning Style. Even though the people use all the three styles i.e. multiple modes to accept information, one style will be dominant than others. The inventory represents three main types of learners as Visual Learners, Auditory Learners and Kinesthetic Learners. Description of each component and example of items are given in the following section.

Visual Learning Style.

A learner with visual learning style learns preferably through seeing i.e. information presented in the visual forms. They are mainly using reading for remembering and understanding the material. The features associated with visual learning style includes,

- Taking notes and enjoy maps
- Using pictures and diagrams for learning

- Want to sit the first row of class to see the teachers' facial expression and body language
- Use colour pens to highlight the important points of the text
- Like to study in calm and quiet environments and use multimedia devices for learning
- Over writing is used as technique for memorisation
- They participate actively in classes.

Example.

I occupy the front seat in the class to get teachers' gestures and expressions properly

Auditory Learning Style.

A learner with Auditory Learning Style learns or receives information by listening to spoken words and verbal instructions. Characteristics associated with auditory learners are:

- They usually try to make an internal conversation between the individual and the text.
- Using techniques such as listening to audio tapes.
- Tutoring other students and discussion with teachers for enhancing their memory.
- Listening to pitch, tone, speed and other nuances for interpreting the inner meaning of the content.
- Prefers directions given orally and seldom takes notes or writes things down

- They prefers lectures to reading assignments and often repeats what has just been said
- They are self talking

Example.

I can understand the places and routes better when told than drawn

Kinesthetic Learning Style.

A learner with kinaesthetic Style learns better through hands on experiences like moving, doing and touching etc. Physical activities are more important for them than reading and listening. The important characteristics associated with this type of learners are:

- They want to manipulate, touch and handle materials and objects while studying and listening
- Often doodles when processing or listening information, excel in sports and mechanics
- Efficient in drawings and play with fingers and talk with hands
- They take frequent brakes and vary their activities
- They visualize complex projects from start to finish.

Example.

While recalling anything I write on the table or anywhere with fingers.

Writing of items.

While writing items, careful attention was made to ensure that each item is measuring the dimension covered which is pre-assigned for the inventory. The investigator prepared items on the basis of previous studies, meta analysis of available tools and discussion with experts for the above three components of the Learning Style and the draft tool was prepared with the help of supervising teacher. Then the investigator discussed with the supervising teacher on ensuring the relevance of each statement prepared, and to remove its ambiguity if any, in its wording. In addition to this the investigator consulted some expert teachers to evaluate items on the basis of classroom practices they followed. After a thorough scrutiny and editing, the final form of draft scale was made. The final version of the draft inventory consisted of 75 items and the items were arranged from 1 to 75 numbers under three sections in such a way that the first 26 items were meant for 'Visual Learning Style' group, the next 18 items meant for 'Auditory Learning Style' group and the last 31 items for 'Kinesthetic Learning Style' group. The draft of Learning Style Inventory in Malayalam and English are presented as Appendices C1 and C2 respectively.

The component wise item numbers are presented in Table 7.

Table 7

Section Wise Item Details of Learning Style Inventory

Leaning Styles	Item Numbers
Visual Leaning Style	1 to 26
Auditory Leaning Style	27 to 44
Kinesthetic Leaning Style	45 to 75

Pilot testing.

The draft scale was administered to a representative group of 400 Secondary School Students with due weightage to sub samples. On completion of the pilot test, incomplete response sheets were discarded.

After random rejection the sample was fixed to 370. The responses of each item by all secondary school dents in the sample were scored and subjected to item analysis.

Item analysis.

For the finalisation of the items of the inventory the procedure suggested by Likert (1932) was used. The style wise responses collected from 370 students were arranged in the descending order based on scores obtained. Then the subjects were grouped as high group and low group respectively. The top 27% students and bottom 27% students were taken as the high group and low group respectively for item analysis. The number of students in lower and upper group was 100 each. The mean and standard deviation of each item were calculated separately for lower and upper groups and t-value was calculated. Items having the t-value above 2.58 were selected for the final version of Learning Style Inventory. The final version of Inventory consists of 52 items. The t-value for each item was calculated using the formula (Formula 1)

$$t = \frac{\overline{X}H - \overline{X}L}{\sqrt{\frac{\sigma_H^2}{N_H} + \frac{\sigma_L^2}{N_L}}}$$

Where

$\overline{X}_H$ = mean of each item in upper group

$\overline{X}_L$ = mean of each item in lower group

σ_H^2 = The variance of the distribution of the response of the upper group to the students.

σ_L^2 = The variance of the distribution of the response of the lower group to the students.

N_H = The number of the subject in the upper group

N_L = The number of the subject in the lower group

The t-values of each item are presented in Table 8.

Table 8

Data and Results of Item Analysis of Learning Style Inventory

Item No	t values	Status	Item No	t values	Status	Item No	t values	Status
1	1.96	Rejected	26	1.99	Rejected	51	4.12	Accepted
2	3.97	Accepted	27	2.88	Accepted	52	2.74	Accepted
3	3.31	Accepted	28	2.93	Accepted	53	2.66	Accepted
4	4.25	Accepted	29	4.87	Accepted	54	2.86	Accepted
5	4.53	Accepted	30	2.88	Accepted	55	2.84	Accepted
6	4.69	Accepted	31	3.32	Accepted	56	2.79	Accepted
7	0.41	Rejected	32	2.69	Accepted	57	4.75	Accepted
8	0.23	Rejected	33	2.80	Accepted	58	1.39	Rejected
9	0.42	Rejected	34	3.38	Accepted	59	3.39	Accepted
10	3.27	Accepted	35	2.58	Accepted	60	3.34	Accepted
11	3.42	Accepted	36	5.05	Accepted	61	2.75	Accepted
12	1.96	Rejected	37	2.79	Accepted	62	1.98	Rejected
13	5.55	Accepted	38	2.92	Accepted	63	4.09	Accepted
14	1.98	Rejected	39	6.34	Accepted	64	2.67	Accepted
15	0.52	Rejected	40	2.75	Accepted	65	3.04	Accepted
16	3.36	Accepted	41	1.98	Rejected	66	1.03	Rejected
17	3.55	Accepted	42	4.26	Accepted	67	0.86	Rejected
18	2.65	Accepted	43	2.85	Accepted	68	2.84	Accepted
19	2.98	Accepted	44	2.99	Accepted	69	5.03	Accepted
20	4.72	Accepted	45	2.96	Accepted	70	1.98	Rejected
21	1.97	Rejected	46	1.96	Rejected	71	2.99	Accepted
22	1.13	Rejected	47	1.07	Rejected	72	3.71	Accepted
23	7.23	Accepted	48	1.99	Rejected	73	2.53	Accepted
24	0.54	Rejected	49	0.19	Rejected	74	2.76	Accepted
25	1.23	Rejected	50	1.17	Rejected	75	3.48	Accepted

Scoring Procedure.

The final inventory consists of 52 items and the responses are collected on a three point likert scale as 'Always', 'Sometimes' and 'Never' and scored as 3/2/1 for items. Item wise score of each category of Visual, Auditory and Kinesthetic Learning Styles for a student are to be summated to obtain a total measure of the three types of Learning Styles of a student.

The draft inventory was administered to a representative group of 400 Secondary School Students with due weightage to sub samples. Incomplete response sheets are discarded. After random rejection the sample was fixed to 370. The responses to each item by all Secondary School Students in the sample were scored and subjected to item analysis.

Establishing validity and reliability.

The validity and the reliability of the tool was ensured by the following ways.

Validity.

It tells that any of the measuring instrument which satisfies the purpose for which it is developed can be a valid one and based upon this inferences and conclusions about the measured scores are executed. Initially the validity of the instrument was established by Face Validity and Content validity.

Face validity.

For this tool the investigator established the face validity by expert evaluation. The investigator consulted the experts in the field of education, psychology and confirmed that the items in the Learning Style Inventory were able to measure the mode of learning of Secondary School Students.

Content validity.

For establishing the content validity, the experts carefully examined the items of the instrument based on the conceptual studies from literature and theoretical evidences, which act as background for the tool preparation. As per the evaluation of the experts, the test content covers the significant concepts and comprehensive enough in terms of the conceptual background.

Criterion validity.

For establishing criterion related validity, the scores obtained by a group of 30 secondary school students in the Learning Style inventory constructed by investigator were correlated with Learning Style Survey Scale constructed by (Cohen, Oxford & Chi, 2001), a six point scale to identify the Learning Style of Secondary School Students. The correlation between the scores of the two measures was found out using Pearson's Product Moment Coefficient of Correlation. The coefficients of validity are shown in Table 9.

Table 9

Criterion Related Validity Coefficients of Scores Obtained on the Learning Style Inventory

Sl. No	Learning Style	Validity Index
1	Visual	0.69
2	Auditory	0.70
3	Kinesthetic	0.69

The coefficient of validity obtained for the inventory shows that the inventory is a valid tool to measure the Learning Style of secondary school students.

Reliability.

Reliability measures provide an estimate of how much variation we might expect under different conditions. The investigator used Test-Retest Method to find out the reliability of the test. For determining the Test-Retest reliability the investigator selected 30 students who attempted the inventory for the first time. The inventory was again administered to that group after three weeks time. Then the two scores were correlated to find out the reliability coefficient. The coefficients of reliability are shown in Table 10.

Table 10

Test-Retest Reliability Coefficients of Scores Obtained on Learning Style Inventory

Sl No	Learning Style	Reliability Coefficient
1	Visual	0.76
2	Auditory	0.75
3	Kinesthetic	0.75

Final version of the tool in Malayalam and English are presented as Appendices C3 and C4 respectively.

Science Process Skills Tests

One of the main objectives behind the construction of the Test of Basic and Integrated Process Skills in Chemistry was to quantify the knowledge of different processes used in the classroom and the results of these processes are the anticipated outcome (Skills) of a specific teaching-learning experience. Process oriented learning in science is proved as one of the way for learning by stimulating inquiry and critical thinking among learners. Investigator analysed various classification of Science Process

Skills like; AAAS (1990); Nay (1971); Klopfer (1971); Mc Cormack and Yager (1989); Harlen and Elstgeest (1992); and Longfield (2003) and found that the Science Process Skills are more or less same as per the classifications. In this study the investigator selected 12 Process Skills by referring the classification followed by American Association for Advancement of Science (AAAS, 1990); (UNESCO, 1992) and NCERT Source Book in Chemistry (2013-2014). Out of the 12 Process Skills seven skills were included under Basic Process Skills and five skills were included under Integrated Process Skills according to age dependent classification of Longfield (2002).

From the review the investigator had noticed some content based foreign tests for measuring Science Process Skills. But their number is very few and could not be able to locate a single specific tool for measuring Process Skills in Chemistry which is suitable to Indian curriculum at the secondary level. Hence the investigator constructed separate tests to measure BPS and IPS of Secondary School Students with the help of supervising teacher.

Test of Basic Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test is meant to measure the Basic Process Skills in Chemistry of the students in secondary schools. The Basic Process Skills are the fundamental skills which act as the stepping stone for higher level skills. During the elementary stage students are in the Concrete Operational Stage as postulated by Piaget (1970) and the Basic Process Skills are acquired from this stage onwards and it extends up to 7^{th} grade. The steps followed and techniques adopted in the development of the test of Basic Process Skills in Chemistry are described in the following sections.

Planning of the test.

The seven Basic Process Skills considered for this test consist of; Skill of Observing, Skill of Comparing/Classifying, Skill of Communicating, Skill of Using Number Relations, Skill of Measuring , Skill of Predicting, and Skill of Inferring. After selecting the 7 Basic Process Skills, the next step was to frame the items on selected skills with due weightage to each skill. In this stage, the investigator studied thoroughly the curriculum, syllabus, and source book for teachers and text book of chemistry for standard VIII and IX pupils for the academic year 2013-2014. For guidance, the investigator consulted with experts such as DIET faculty, State level resource person in Chemistry, Higher secondary school teachers and other experienced secondary school teachers in Chemistry.

Preparation of the test.

In order to measure the Basic Process Skills in Chemistry of Secondary School Students, a list of items to measure the select process skills was constructed by the investigator. It was decided to develop a test comprises of 60 multiple choice items for 90 minutes duration. The areas chosen for constructing test items covered the Chemistry syllabus for $8^{th}$and 9^{th} standards of Kerala state followed during the academic year 2013-2014. Content analysis of the text books of standard 8^{th} and 9^{th} was carried out initially and it includes the topics namely, Nature of Materials, Separation of Mixtures, Periodic Table and Chemical Bond, Acids and Alkalis, Non Metals and Carbon from 9th standard Physical Science Text book Prepared by SCERT in 2010 and Changes, Structure of Atoms, Atoms and Molecules, Metals and Water from 8th standard physical Science Text Book prepared by SCERT in 2009. While analysing the content, the skills mentioned for a particular unit is also searched. Different sources of information used for the construction of items were text book, other reference books mentioned in the syllabus, source book for teachers and question banks. Other sources used for the preparation of test includes Science Teaching and Testing (Nedelsky, 1965), Teaching Physical Science in Secondary Schools (Gupta, 1981) and Science Teaching in Schools (Das, 1985). Prepared items are subjected to scrutiny by experts in the field of science education. The items were re-edited in the light of expert's criticism. As a result of this, some new items are added and some items are removed and rearranged, finally the draft test consists of 60 items, covering the seven Basic Process Skills is considered for the study. All questions in the test are multiple choice questions and these measure Basic Process Skills involved in the scientific process of Inquiry.

Basic Process Skills used were; Skill of,

- Observing
- Comparing/classifying
- Communicating
- Using number relations
- Measuring
- Predicting and
- Inferring

All these skills are interrelated and it follows a sequence from initial to higher stage in inquiry process. Characteristics of these Basic Process Skills are detailed as follows:

1. ***Observing***.

This is the principal way in which people obtain information about their environment through the five senses, namely, sight, smell, touch, taste and hearing (Rezba, Funk, Okey & Jaus, 1995). The sub skills included under observation skills are:

- Observes the natural phenomena using senses
- observe similarities and differences
- observe qualitative and quantitative changes

Example.

From your daily observation, which of the following is an example of chemical change?

a. Burning of Magnesium
b. Melting of Ice
c. Evaporation of Water
d. Melting of Wax

2. ***Classifying/comparing***.

This requires people to organize their observations in ways that carry special meaning. People classify these in order to comprehend them. Classification takes place through observing similarities, differences and interrelationships. The sub skills included under classification skills are:

- Identify the reference for classification purpose

- Classify the objects qualitatively and quantitatively based on common properties
- Classify the objects both unidirectional and multidirectional

Example.

Which of the following element has greatest stability?

a. Nitrogen
b. Oxygen
c. Fluorine
d. Neon

3. ***Communicating***.

Learners communicate knowledge and ideas to others through verbal method or non verbal method. In this, learners can use communication tools such as graphs, charts, maps, symbols, diagrams, mathematical equations, visual demonstration, written and spoken words to communicate vital information. The sub skills under communication skills are:

- Uses non verbal means like chemical symbols, words, and graphics to describe the object or event
- Use verbal means like written or spoken words
- Use secondary sources for representing ideas and models

Example.

Which of the following is the chemical formula of sulphuric acid?

a. HCI
b. HNO_3

c. H_2SO_4

d. H_3SO_4

4. ***Using numbers***.

Learners can effectively use the rational numbers for quantifying an object and can understand their values, properties and usages in appropriate situation. In this pupil shows their ability in:

- Naming rational numbers and arranging them
- Using symbols in mathematics
- Describe the concepts based on number properties

Example.

Molecular structure of water is made up of

a. 2 elements and 3 atoms

b. 2 elements and 2 atoms

c. 3 elements and 2 atoms

d. 3 elements and 3 atoms

5. ***Measuring***.

This is the process by which learners' measure angles, numbers, sizes, lengths or distances, volumes and mass. Measurement involves comparison of entity with a standard value. Sub skills of measurement include:

- Awareness about different measuring devices
- Receives competence in qualifying physical variables through direct and indirect measurement
- Gained knowledge about units of measurement

Example.

The electronic configuration of potassium is 2,8,8,1 and for calcium it is 2,8,8,2. From this identify the element with lowest number of atom

a. Ca
b. Zn
c. Fe
d. K

6. ***Predicting***.

Funk (1985) defined this as "a forecast of what a future observation might be". Predictions are kinds of thinking that require learners' best guesses based on the information available to them. In this learners are supposed to be able to forecast the properties and the occurrence of various phenomena like drought, floods, and hurricanes etc. Prediction can be based on the use of available evidence or past experiences but there should be proper justification for the prediction (UNESCO, 1992). Sub skills included in prediction involve:

- Relevant prior knowledge related to the topic
- Test the predicted things based on experience

Example.

I am an element, for the first time Joseph Priestly prepared me by heating Mercuric Oxide and without me you can't exist. Guess who am I?

a. H
b. O
c. N
d. F

7. ***Making Inferences***.

This is a process of concluding about the cause of an observation. Direct observation of objects or events enables people to suggest something, to interpret and explain things and activities happening in their environment. For instance, an explanation or interpretation of an observation is indeed an inference (Funk, 1985). This involves Skills to:

- Formulate assumptions based on observations
- Identify cause and effect relationship
- Think about more than one inference based on all observations

Example.

The P^H of vinegar is 5 and the P^H of rain water is 6. From the statements given below, which explanation is more appropriate?

a. Both are bases, though vinegar is more basic
b. Both are acidic, though vinegar is more acidic
c. Both are bases, though rain water is more basic
d. Both are acids, though rain water is more acidic

The weightage given to each Basic Process Skill included in the test are given in Table 11.

Table 11

Data Showing Weightage Given to Basic Process Skills in Chemistry

Sl No.	Basic Process Skills	No. of Questions	Marks	Percentage (%)
1	Observing	10	10	16.7
2	Classifying/comparing	8	8	13.3
3	Communicating	6	6	10
4	Using Numbers Relations	9	9	15
5	Measuring	7	7	11.7
6	Predicting	8	8	13.3
7	Inferring	12	12	20
	Total	60	60	100

Pilot test.

The draft test with 60 multiple choice items were tried out by the investigator on a representative sample of 400 Secondary School Students. Before the administration of the test, the purpose of the test was made clear to the subjects. The test included the necessary instructions about the test and additional information needed was given by the investigator at the time of administration. The test materials and response sheets of sufficient numbers were provided to the students. One score each was given for a correct response and no score were given for wrong answers. The sum of the scores for the 60 items was taken as the total score for the test. From the 400 response sheets, after rejection of incomplete response sheets, the investigator used 370 answer sheets for item analysis. The draft Test of Basic Process Skills in Chemistry in Malayalam language and its English version and Scoring Key are presented in Appendices D1, D2 and D3 respectively.

Item analysis.

Item analysis is the process to assess the quality of the individual test items and of the whole test by examining the responses of the administered group. It is helpful for improving the items and to eliminate ambiguous or incorrect items in a single test administration. The quality of a test depends on the individual item of which it is composed. So it is necessary to analyse whether each item is useful for the purpose to which it is being constructed. It was done as per the procedure suggested by Ebel (1965). For this the investigators arranged the selected response sheets either in ascending or descending order. Then separated 27% from the highest group and 27% from the lowest group. So the upper group consist of 100 response sheets and the lower group consist of 100 response sheets. The middle 170 were discarded. Each item in the response sheet were tallied for the hundred high scores (U) and hundred low scores (L). In order to select items the discriminating power and difficulty index of each item were found out.

Difficulty index.

Difficulty index (Di) of an item is represented by the percentage of students who respond correctly to each item. The range of (Di) is zero to one; the higher value of Di implied that the larger proportions of respondents make correct response to the item and it was thus an easy item. Difficulty index was calculated using the following formula suggested by Ebel (1972).

$$\textit{Difficulty index (Di)} = \frac{\boldsymbol{U+L}}{\boldsymbol{2N}}$$

Where

U = number of correct responses in the upper group

L = number of correct responses in the lower group

N = number of pupils in any group

Discriminating power.

Discriminating power (Dp) of an item is the quality of an item to discriminate between respondents with high and low knowledge. It is based on the difference between correct response in the lower group and upper group. The range of Discriminating power is possibly between -1 to +1. The investigator used the formula;

Discriminating power (Dp) = $\frac{\boldsymbol{U-L}}{\boldsymbol{N}}$

Where

U = number of correct responses in the upper group

L = number of correct response in the lower group

N = number of pupils in any group

Selection of items.

Garret (1973) suggested that items with validity indices of 0.20 or more and difficulty indices of .40 and .60 are regarded satisfactory. Ebel and Frisbie (1991) provided a guideline for choosing items with respect to their discrimination power. It is given in Table 12.

Table 12

Discriminating Power and Its Interpretation according to Ebel and Frisbie (1991)

Discrimination power	Interpretation
0.40 and up	Very good items
0.30 to 0.39	Reasonably good
0.20 to 0.29	Marginal items, subject to improvement
0.19 or less	Poor items, to be rejected or improved by revision

Ebel (1965) provides an interpretation of difficulty index which is given in the Table 13.

Table 13

Nature of Item and Difficulty Index as Interpreted by Ebel (1965)

Nature of Item	Difficulty Index
Very easy	0.91 and above
Easy	0.76 to 0.90
Optimum difficulty	0.26 to 0.75
Difficult	0.11 to 0.25
Very difficult	0.10 and below

The investigator decided to select from the total items of draft test having discriminating power more than 0.4 and difficulty index between 0.4 and 0.6 initially. When adequate numbers of items were not available, the investigator decided to make some adjustments in this limit. Some items having the difficulty index in between 0.29 and 0.72 with discriminating power 0.3 and above were selected. Thus the investigator prepared the final test with 36 multiple choice items selected from the draft test. The time duration fixed for the test was 45 minutes and the maximum score of the test was 36. The difficulty index and discriminating power of each item are given in Table 14.

Table 14

Difficulty Index (Di) and Discriminating Power (Dp) for 60 Items of Test of Basic Process Skills in Chemistry for Secondary School Students

Item No	Di	Dp	Status	Item No	Di	Dp	Status
1	0.50	0.53	Selected	31	0.88	0.39	Selected
2	0.80	0.36	Selected	32	0.45	0.26	Rejected
3	0.05	0.03	Rejected	33	0.25	0.25	Rejected
4	0.63	0.60	Selected	34	0.63	0.00	Rejected
5	0.80	0.13	Rejected	35	0.25	0.14	Rejected
6	0.83	0.13	Rejected	36	0.36	0.58	Selected
7	0.93	0.38	Selected	37	0.88	0.38	Selected
8	0.91	0.39	Selected	38	0.31	0.23	Rejected
9	0.83	0.13	Rejected	39	0.75	0.45	Selected
10	0.75	0.43	Selected	40	0.66	0.46	Selected
11	0.73	0.40	Selected	41	0.65	0.10	Rejected
12	0.61	0.16	Rejected	42	0.88	0.34	Selected
13	0.81	0.38	Selected	43	0.63	0.26	Rejected
14	0.80	0.33	Selected	44	0.18	0.23	Rejected
15	0.55	0.53	Selected	45	0.76	0.46	Selected
16	0.93	0.66	Selected	46	0.11	0.14	Rejected
17	0.73	0.16	Rejected	47	0.55	0.26	Rejected
18	0.73	0.13	Rejected	48	0.85	0.39	Selected
19	0.28	0.16	Rejected	49	0.78	0.43	Selected
20	0.72	0.46	Selected	50	0.66	0.60	Selected
21	0.75	0.51	Selected	51	0.71	0.37	Selected
22	0.80	0.34	Selected	52	0.43	0.27	Rejected
23	0.70	0.38	Selected	53	0.43	0.27	Rejected
24	0.70	0.38	Selected	54	0.76	0.36	Selected
25	0.71	0.52	Selected	55	0.95	0.18	Rejected
26	0.78	0.36	Selected	56	0.86	0.39	Selected
27	0.81	0.36	Selected	57	0.81	0.36	Selected
28	0.15	0.14	Rejected	58	0.53	0.45	Selected
29	0.25	0.14	Rejected	59	0.15	0.21	Rejected
30	0.33	0.66	Selected	60	0.52	0.36	Selected

Validity of the test.

Validity is an indispensable characteristic of measuring devices. The validity of a test may be defined as the accuracy with which it measures what it is intended to measure or as a degree in which it approaches infallibility in measuring what it purports to measure. For ensuring the validity of the test, initially the investigator used content validity and face validity.

Content validity

As the name indicates, this form of validity is estimated by evaluating the relevance of the test item individually and as a whole (Freeman, 1976). For establishing the content validity of the Basic Process Skills Test, the investigator subjected the test to the group of experts for careful examination of the content, skills and the meticulous analysis of the test items. As per the judgement of the experts, the test content covers the significant concepts and comprehensive enough in terms of the selected process skills. Thus the content validity of the Test of Basic Process skills in Chemistry was established.

Face validity.

To establish the face validity, the Basic Process Skills test was submitted before the subject experts who certified that the test appears qualities of a test comply with weightage to skills, content matters and is competent for the purpose, thus ensuring face validity.

Criterion validity.

For assuring Criterion Related validity, the scores obtained by a group of 52 students from 8th standard in the Basic Science Process Skills test were correlated with their Chemistry terminal examination achievement scores. The correlation between the scores of the two measures was found out using Pearson's Product Moment Coefficient of Correlation. The validity coefficient obtained was found to be 0.72. It suggests that this test is a highly valid test to measure the Basic Process Skills of secondary students.

Reliability of the test.

The reliability of a test means the extent to which it is dependable. For measuring the reliability of the present test, investigator used Test-Retest Method.

Investigator administered the Test of Basic Science Process Skills in chemistry among 40 students who were undergone the same test earlier, and the time interval between the test ad retest was of three weeks. Correlations between the test and retest were found by Pearson's Product Moment Formula. The reliability coefficient obtained is 0.78 which shows the present test is highly reliable. The obtained value of reliability suggests that the test has acceptable psychometric qualities to measure the Basic Process Skills in Chemistry of Secondary School Students. A copy of the final test in Malayalam, its English version, response sheet and scoring key are given in Appendices D4, D5, D6 and D7 respectively

Test of Integrated Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test is meant to measure the Integrated Process Skills in Chemistry of Secondary School Students. The Integrated Skills are the complex skills which is inevitable for the scientific inquiry process. During the secondary stage students are in the formal operational stage and the integrated process skills are acquired from this stage onwards and extend up to the completion of adolescence. The steps followed and techniques adopted in the development of the test of integrated Process Skills in Chemistry are described in the following sections.

Planning of the test.

The five Integrated Process Skills considered for this test consist of; Skill of Hypothesising, Skill of Controlling/Identifying Variables, Skill of Interpreting Data, Skill of Analysing, and Skill of Generalising. After selecting the five Integrated Process Skills, the next step was to frame the items on selected skills with due weightage to each skill. In this stage, the investigator studied thoroughly the curriculum, syllabus, source book for teachers and text book of chemistry for standard VIII and IX pupils for the academic year 2013-2014. For guidance, the investigator consulted with experts such as DIET faculty, State level resource person in Chemistry, Higher secondary teachers and other experienced secondary teachers in Chemistry.

Preparation of the test.

In order to measure the Integrated Process Skills in Chemistry of Secondary School Students, a list of items to measure the selected process skills was constructed by the investigator. It was decided to develop a test comprises of 43 multiple choice items for 50 minutes duration. The areas chosen for constructing test items covered the chemistry syllabus for $8^{th}$and 9^{th} standards of Kerala state followed during the academic year 2013-2014.

The topics for preparing the items of the test were the same as used for the Test of Basic Process Skills in Chemistry. While analysing the content the Integrated Process Skills needed for a particular unit is also searched. Different sources of information used for the construction of items were text book, other reference books mentioned in the syllabus, Teachers' Source books for VIIIth & IXth standards and question banks. Other sources used for the preparation of test includes Science Teaching and Testing (Nedelsky, 1965), Teaching Physical Science in Secondary Schools (Gupta, 1981) and Science Teaching in Schools (Das, 1989). The prepared items are subjected to scrutiny by experts in the field of science education. The items were re-edited in the light of expert criticism. As a result of this, some new items were added and some items were removed and rearranged, finally the draft consists of 60 items covering the five Integrated Process Skills considered for the study. All questions in the test are multiple choice questions and these measures Integrated Process Skills involved in the scientific process of Inquiry.

Integrated Process Skills used were; Skill of :

- Hypothesising
- Controlling/Identifying Variables
- Analysing
- Interpreting Data and
- Generalising

All these skills are interrelated but there is no sequence or order for it. Characteristics of these Integrated Process Skills are as follows:

1. ***Hypothesizing***.

Children form and make suggested solution to a problem from observations or events. These are the proposed solutions or expected outcomes for a problem. They learn to seek generalisable information over limited information. In this, pupils are able to:

- Predict variation in the dependent and independent variables
- Provide rationale for a hypothesis
- Determine the testability of a hypothesis based on materials provided

Example.

What is the reason for using filter paper for separating water from the mixtures of water & mud and water & choak

a. Difference in size of the particles
b. Property of evaporation
c. Colour of particles
d. Magnetic property

2. C***ontrolling/Identifying Variables***.

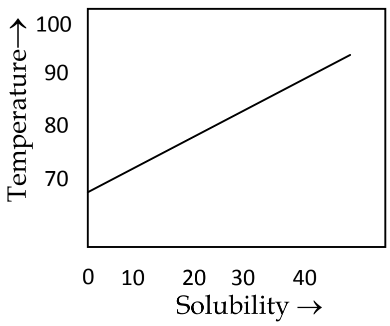
Children are taught to observe events and interactions carefully then suggest tests for inferences under controlled situations. In this, students want to identify the changeable factors that can change it. During this stage the pupil can be able to

- Identify the variables

- Determine the dependent and independent variables
- Understand the manipulation of variables

<u>Example.</u>

From the picture below, what is the relationship between solubility and temperature?



a. Solubility increases when temperature decreases

b. Solubility increases when temperature increases

c. Solubility remains constant

d. None of these

3. Analysing.

It is a complex ability of breaking down a meaningful components in to fractions. For carrying out this process initially students need to have an overall picture of the phenomenon and their formation. Systematic analysis leads to the meaningful conclusion. In this stage students can:

- Identify steps and processes
- Categorises the steps
- Draw conclusions

Example.

Suppose two beakers A and B contains solutions of sugar. When we add little more sugar in to both of these beakers, it will soluble in beaker 'A' but not soluble in beaker 'B'. In the above solutions which is solute?

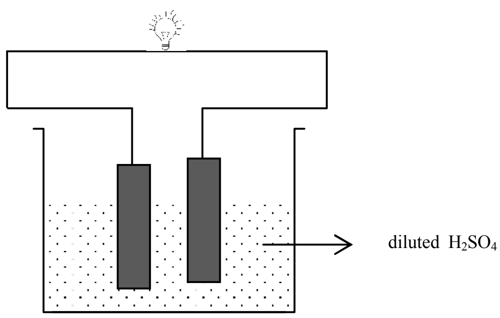
a. Water
b. Sugar
c. Sugar Solution
d. None of these

4. *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. This process refers to the intrinsic ability to recognize patterns and associations within bodies of data. Following skills are used during this stage:

- Find out the association between the data
- Interpret the data statistically based on result
- Find out the patterns and sequences of data

Example.



From the above picture, what is the energy change taken place while glowing a bulb?

a. Heat Energy $\longrightarrow$ Electrical Energy
b. Light Energy $\longrightarrow$ Electrical Energy
c. Chemical Energy $\longrightarrow$ Light Energy
d. Magnetic Energy $\longrightarrow$ Electrical Energy

5. Generalising.

It is a complex behaviour involving higher mental processes. In this, students are able to make a comparison between their finding with other results of the similar nature. By considering the situations, nature and the properties of phenomenon under study; the results can be generalised in to a population of similar nature. In this stage skills used are:

- Identify the similarities and differences in findings
- Examine the conditions and environments
- Formulate suitable explanation

Example.

Besides being valuable, gold is special because it can be hammered in to a very thin foil. This property is called

a. Malleability
b. Ductility
c. Conductivity
d. Sonority

The weightage given to each Integrated Process Skill included in the test are given in Table 15.

Table 15

Data Showing Weightage Given to Integrated Process Skills in Chemistry

SI No.	Integrated Process Skills	No. of Questions	Marks	Percentage (%)
1	Hypothesising	8	8	18.60
2	Controlling Variables	6	6	13.96
3	Analysing	11	11	25.58
4	Interpreting Data	8	8	18.60
5	Generalising	10	10	23.26

Pilot test.

The draft test with 43 multiple choice items were tried out by the investigator on a representative sample of 400 Secondary School Students. Before the administration of the test, the purpose of the test was made clear to the subjects. The test included the necessary instructions about the test and additional information needed were given by the investigator at the time of administration. The test materials and response sheets in sufficient numbers were provided to the students. One score was given for a correct response and no score was given for wrong answers. The sum of the scores for the 43 items was taken as the total score for the test. From the 400 response sheets, after rejection of incomplete response sheets, the investigator used 370 answer sheets for item analysis. The draft Test of Integrated Process Skills in Chemistry in Malayalam, its English version and Scoring Key are presented in Appendices E1, E2 and E3 respectively.

Item analysis.

For this the investigators arranged the selected response sheets either in ascending or descending order and then separated 27% from the highest group and 27% from the lowest group. So the upper and lower groups consisted of 100 response sheets each. The middle 170 was discarded. Each item in the response sheet were tallied for the hundred high scores (U) and hundred low scores (L). In order to select items the discriminating power and difficulty index of each item were found.

Difficulty Index

Difficulty index was calculated using the following formula suggested by Ebel (1965).

Difficulty index (Di) = $\frac{\boldsymbol{U+L}}{\boldsymbol{2N}}$

Where

U = number of correct responses in the upper group

L = number of correct responses in the lower group

N = number of pupils in any group

Discriminating power.

Discriminating power (Dp) was calculated using the following formula suggested by Ebel (1965).

Discriminating power (DP) = $\frac{\boldsymbol{U-L}}{\boldsymbol{N}}$

Where

U = number of correct responses in the upper group

L = number of correct response in the lower group

N = number of pupils in any group

Selection of items.

The investigator decided to select from the total items of draft test having discriminating power more than 0.4 and difficulty index between 0.4 and 0.6 initially. When adequate numbers of items were not available, the investigator decided to make some adjustments in this limit. Some items having the difficulty index in between 0.29 and 0.72 with discriminating power 0.3 and above were selected. Thus the investigator prepared the final test with 33 multiple choice items selected from the draft test. The time duration fixed for the test was 40 minutes and the maximum score of the test was 33. The difficulty index and discriminating power of each item are given in Table 16.

Table 16

Difficulty Index (Di) and Discriminating Power (Dp) for 43 Items of Test of Integrated Process Skills in Chemistry for Secondary School Students

Item No	Di	Dp	Status	Item No	Di	Dp	Status
1	0.78	0.36	Selected	23	0.71	0.39	Selected
2	0.83	0.36	Selected	24	0.81	0.36	Selected
3	0.81	0.21	Rejected	25	0.66	0.60	Selected
4	0.40	0.73	Selected	26	0.61	0.56	Selected
5	0.62	0.53	Selected	27	0.81	0.14	Rejected
6	0.95	0.18	Rejected	28	0.62	0.53	Selected
7	0.43	0.32	Selected	29	0.78	0.43	Selected
8	0.76	0.36	Selected	30	0.81	0.42	Selected
9	0.81	0.36	Selected	31	0.76	0.26	Rejected
10	0.93	0.46	Selected	32	0.90	0.36	Selected
11	0.38	0.23	Rejected	33	0.91	0.39	Selected
12	0.71	0.13	Rejected	34	0.76	0.46	Selected
13	0.76	0.46	Selected	35	0.76	0.46	Selected
14	0.15	0.21	Rejected	36	0.81	0.23	Rejected
15	0.91	0.49	Selected	37	0.78	0.36	Selected
16	0.78	0.43	Selected	38	0.88	0.16	Rejected
17	0.45	0.43	Selected	39	0.76	0.46	Selected
18	0.53	0.45	Selected	40	0.75	0.52	Selected
19	0.73	0.53	Selected	41	0.95	0.18	Rejected
20	0.72	0.61	Selected	42	0.85	0.42	Selected
21	0.52	0.36	Selected	43	0.84	0.33	Selected
22	0.76	0.39	Selected				

Validity of the test.

For ensuring the validity of the test initially the investigator used content validity and face validity.

Content validity.

For establishing the content validity of Test of Integrated Process Skills, the investigator subjected the test to the group of experts for careful examination of the content, skills and the meticulous analysis of the test items. As per the judgement of the experts, the test content covers the significant concepts and comprehensive enough in terms of the selected process skills. Thus the content validity of the Test of Integrated Process skills in Chemistry was established.

Face validity.

To establish the face validity of the Integrated Process Skills test, it was submitted before the subject experts who certified that the test appears qualities of a test comply with weightage to each skill, and the content matters are competent for the purpose, thus ensuring face validity.

Criterion validity.

For assuring criterion related validity, the scores obtained by a group of 50 students from 9^{th} standard in the Integrated Science Process Skills test were correlated with their Chemistry terminal examination achievement scores. The correlation between the scores of the two measures was found out using Pearson's Product Moment Coefficient of Correlation. The validity coefficient obtained was found to be 0.74. It suggests that this test is a highly valid test to measure the Integrated Process Skills of secondary students.

***Reliability of the test*.**

The reliability of a test means the extent to which it is dependable. For measuring the reliability of the present test, investigator used Test-Retest Method.

Investigator administered the Test of Integrated Science Process Skills in Chemistry among 40 students who have undergone the same test earlier. The time interval between the test and retest was of three weeks. Correlations between the test and retest were found by Pearson's product moment formula. The reliability coefficient obtained is 0.79 which shows the present test is highly reliable. The obtained value of reliability suggests that the test has acceptable psychometric qualities to measure the Integrated Process Skills in Chemistry of secondary school students. A copy of the final test in Malayalam, its English version, response sheet and scoring key are given in Appendices E4, E5, E6 and E7 respectively..

Sample Selected for the Study

Secondary School Students in Kerala state were considered as the population for the study. Even though the size of the population is finite, due to its large size, it is impossible and impracticable to study the population characteristics as a whole. Therefore it was decided to take a representative sample of the population. To meet the representativeness in the sample selection, the investigator had to decide three major- aspects of sampling viz., technique of sampling, factors to be considered for selecting the sample and the size of the intended sample.

Technique of Sampling

As the population consisted of large number of pupils belonging to different strata based on Gender, Locale and Type of Management of the Institutions, the investigator adopted stratified random sampling method and each stratum in the population is represented in the sample. "When the population is composed of subgroups or strata of different sizes, stratified sampling method is applicable" (Garatte, 1966).

Factors Considered in Selection of the Sample

Factors taken into consideration while selecting the sample were i) Gender of the students, ii) Locale of the Institution and iii) Type of Management of the Institution.

Gender.

The secondary school students consisted of both male and female students. Many of the studies on process skills reflected that gender is a significant factor effecting process skills since the boys are more curious and discovery oriented than girls even though girls are high on marks or grades. In order to get due representation of gender, the investigator adopted stratified random sampling to collect data from male and female students.

Locality of the institution.

In Kerala the educational institutions are mostly located either in Urban or in Rural area and the students of urban area are being with good infrastructural facilities and learning conditions which may enhance their process skills. The investigator gave due representation to urban and Rural secondary schools.

Type of Management of the Institution.

Majority of the schools in Kerala are run and managed by the Government of Kerala, and these schools are following state syllabus. These groups mainly comprised of Government, Aided and Unaided schools. For the present study the investigator gave due representation to Government and Aided Schools. Unaided schools are not selected because of practical difficulties.

Size of the Sample

Krech and Crutchfield (1968) have observed that sample size of 500 would yield reasonably good results which would keep the error less than five percent. By considering the above factors, the study was proposed to be conducted on a sample of 980 secondary school students of Kerala. This sample was to be drawn from sixteen schools of six revenue districts, viz., Kollam, Thrissur, Palakkad, Malappuram, Kozhikode and Kannur, giving representation to north, south and central regions of Kerala State. Data were collected initially from 1010 secondary school students. The incomplete response sheets were rejected and the sample size was reduced to 980. The details of the sample are presented in Table 17.

Table 17

Details of Sample Selected for the Study

Sl. No.	Name of the School	Rural/ Urban	Govt/ Aided	No. of Boys	No. of Girls	Total
1	VPKM HSS Puthurpallikkal (Malappuram)	Rural	Aided	20	25	45
2	VHMHSS Morayoor (Malappuram)	Rural	Aided	19	23	42
3	Calicut University Govt Model School (Malappuram)	Rural	Govt	20	28	48
4	Govt THSS, Manjeri (Malappuram)	Urban	Govt	32	16	48
5	Govt HSS, Tirurangadi (Malappuram)	Rural	Govt	22	23	45
6	PPMHSS, Kodoor (Malappuram)	Rural	Aided	22	27	49
7	GVHSS Cheruvannur (Kozhikode)	Urban	Govt	17	25	42
8	Govt Ganapath HSS (Kozhikode)	Urban	Govt	17	24	41
9	Farook HSS, Feroke(Kozhikode)	Urban	Aided	18	25	43
10	JDT HSS, Vellimadukunnu (Kozhikode)	Urban	Aided	18	27	45
11	Govt Brennan HSS, Thalassery (Kannur)	Urban	Govt	16	24	40
12	Mubarak HSS, Thalassery (Kannur)	Rural	Aided	23	28	51
13	St Annes HSS, Thrissur (Thrissur)	Urban	Aided	0	36	36
14	Govt Boys HSS, Puranattukara (Thrissur)	Rural	Govt	26	17	43
15	Govt Model HSS (Thrissur)	Urban	Govt	17	28	45
16	Govt HSS, Anchal East (Kollam)	Urban	Govt	21	30	51
17	Thadikkadu HSS, Thadikkadu (Kollam)	Rural	Aided	15	27	42
18	PKM HSS, Roaduvila (Kollam)	Rural	Aided	18	28	46
19	Govt HSS, Anchal West (Kollam)	Urban	Govt	10	18	28
20	Govt HSS, Cherpulassery (Palakkad)	Urban	Govt	22	29	51
21	MES HSS, Mannarkadu(Palakkad)	Rural	Aided	20	31	51
22	Ramanattukara HSS (Malappuram)	Rural	Aided	19	29	48

Out of the total sample of 980, 412 were male and 568 were female students. 401 students belonged to Government Schools and 579 belong to Aided Schools. 510 secondary school students were selected from Rural schools while 470 samples were selected from Urban Schools. The final break- up of the sample is presented in the following Figure 3.

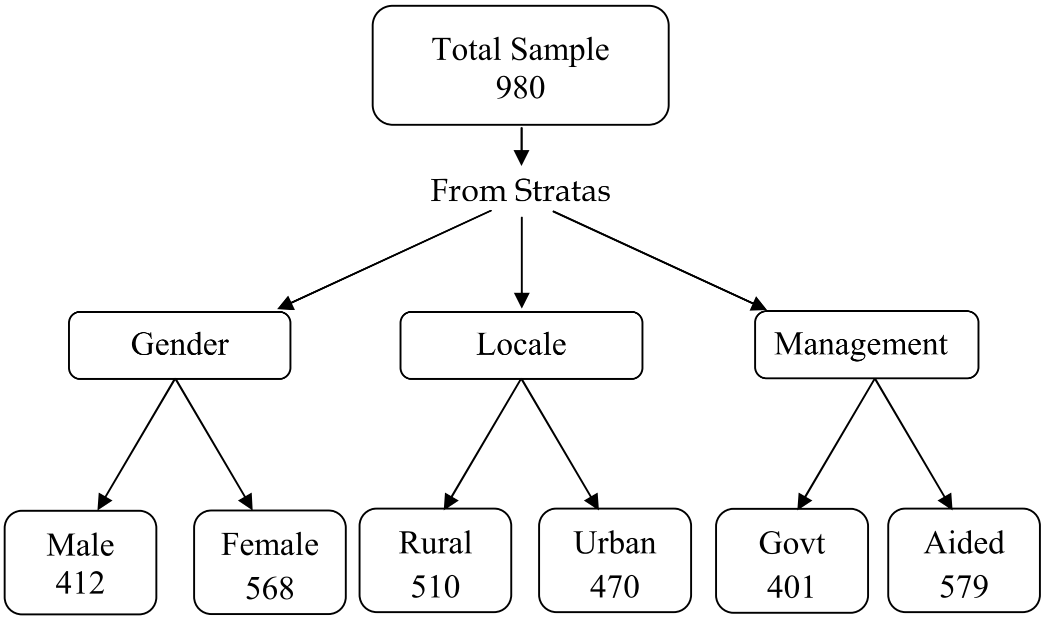


Figure 3. Final break-up of the sample selected for the study

Data Collection Procedure

Administration of the tests was done after getting permission from the Principals of selected schools. The investigator personally visited the schools, contacted the Head of the institutions and convinced them about the necessity of administering tests. The investigator arranged sufficient number of copies of the test booklets and response sheets before administering the tests to the sample the investigator familiarised the students about test taking procedures. The aim and scope of the study was briefly conveyed to the students for clearing the confusions, if any, in taking the tests. After seeking their full co-operation, the procedure for making the response for each test was explained to them. Sufficient interval was given in between different tests. The time limits, rules and procedures in the test manuals were strictly observed. All the four tools were administered to the standard IX or X students of different schools belonging to different districts. It was not possible to administer the four tools at a stretch. Therefore, the investigator used two consecutive days or three days for completing the collection of data from a single school. At the time of filling response sheets the investigator ensured that students were responding to the all items. The investigator didn't provide the separate response sheets for answering and it make easy for students to answer the items at a time. It takes five periods of 45 minutes to administer all the tools. The data collected were systematically consolidated for analysis.

After scoring, the responses were consolidated by incorporating students' Gender, Locale and Type of Management of School. The data was entered in the way that it enabled the statistical analysis by using a computer.

Scoring and Consolidation of Data

The investigator followed the specific directions given in the respective test manuals for scoring and answer scripts were scored accordingly. Separate method of scoring was used for the positive and negative items for the tools namely, Scale of Metacognitive Awareness, Scale of Goal Orientation and Learning Style Inventory. Punched scoring key was used for the Test of Basic and Integrated Process Skills in Chemistry. Incomplete response sheets were rejected and cases which are completed in all respects were taken in to consideration. Thus a final sample of **980** Secondary School pupils was consolidated for further analysis. All entries were coded by using single digits for facilitating computer feeding. Thus the entire data were arranged in such a way that they can be used for processing by the computer.

Classificatory Techniques Used for the Study

Different statistical techniques were used for testing the hypotheses formulated for the study. As the first step of analysis, the Predictor Variables selected for the study were classified in to different levels. The entire statistical processing was done by computer. The classification techniques of each independent variable are presented in the following sections.

Classification of Metacognitive Awareness.

Total sample was divided in to three groups on the basis of Metacognitive Awareness using mean and standard deviation scores as cut off points. Metacognitive Awareness was classified in to three groups namely, High Metacognitive Awareness Group (HMA), Moderate Metacognitive Awareness Group (MMA) and Low Metacognitive Awareness Group (LMA). For this, the mean and the standard deviation of the scores obtained in the Scale of Metacognitive Awareness were calculated first. Students who fall above the Mean + 1 SD were considered as high Metacognitive Aware Group, students who scored under Mean-1SD were considered as Low Metacognitive Awareness Group and students coming in between Mean + 1SD and Mean - 1SD were categorised as Moderate Metacognitive Awareness Group.

Classification of Goal Orientation.

The data collected using the Scale of Goal Orientation was classified to identify the students belonging to Mastery Goal Orientation, Performance -Approach Goal Orientation and performance-Avoidance Goal Orientation. The final Scale of Goal Orientation consisted of 38 items in which 20 items belonged to the dimension of Mastery Orientation, 11 items belonged to Performance–Approach dimension and 7 items belonged to Performance-Avoidance dimension of Goal Orientation. The scores obtained by each student in Mastery, Performance-Approach and Performance-Avoidance Goal Orientations were calculated and these scores were converted in to standard scores for comparison. Mean and Standard Deviation for each category of Goal Orientation is calculated and the extent of selection of each goal is determined by the comparison of mean scores. The goal with higher mean value will be considered as the Goal Orientation of that particular individual. In this manner, the entire sample was classified in to Mastery, Performance-Approach and Performance-Avoidance Goal Orientation groups.

Classification of Learning Styles.

The data collected using the Learning Style Inventory was classified to identify the students with Visual Learning Style, Auditory Learning Style and Kinaesthetic Learning Style. The Learning Style Inventory consisted of 52 items in which 14 items belonged to the dimension of

Visual Learning Style, 17 items belonged to Auditory Learning Style and 21 items belonged to the Kinesthetic Learning Style. The score obtained by each student in Visual, Auditory and Kinesthetic Learning Styles were calculated and these scores were converted in to standard scores for comparison. Mean and Standard Deviation for different Learning Styles is calculated and the extent of preference of Learning Styles is determined by the comparison of mean scores. The Learning Style with higher mean value was considered as the preferred style of that particular subject. In this manner, the entire sample was classified in to Visual, Auditory and Kinaesthetic Learning Styles.

Statistical Techniques Used

For the analysis of collected data, different statistical techniques were used. The statistical techniques used in the present study can be divided in to four categories. They are described as follows.

Descriptive Statistics

Basic Descriptive statistics such as Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis of each independent variable and the dependent variable were calculated. Descriptive Statistics were calculated for the total sample and separately for the sub sample based on Gender, Locale and Type of Management of Secondary School Students. Descriptive Statistics were computed to identify the nature of distribution of predictor Variables and the Criterion Variables.

Mean Difference Analysis

For the study, Test of Significance of Difference between Means for Large and Small Independent samples was used, wherever appropriate, to compare the relevant variables between different groups (Garrett, 1979). This statistical test of significance was used to test whether the Predictor Variables and the Criterion Variables differ based on subsamples. As a preliminary analysis, the investigator established that the data were normally distributed and the basic statistical indices are calculated for the total and relevant subsamples. In this study t test was used to study the Gender difference, Locality Difference and Difference Based on the Type of Management of Institution for the Predictor Variables; Metacognitive Awareness, Goal Orientation, Learning Styles and for the Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry of Secondary School Students. Test of significance of Difference between means of large independent sample was used to compare the mean scores. For the large sample, the following formula suggested y Garrett (1979) was used

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

Where,

M_1 and M_2 are the means of the groups

σ_1 and σ_2 are the standard deviations of the groups

N_1 and N_2 are the sample size of the groups

If the 't' value obtained $\geq \pm$ 2.58, the difference between mean was considered to be significant at 0.01 level. If the 't' value obtained was $\geq \pm$ 1.96, it was considered to be significant at 0.05 level.

Coefficient of Correlation (r)

Coefficient of correlation measure is used to quantify the direction and strength of the relationship between two variables. "It is the ratio which expresses the extent to which changes in one variable are accompanied by changes in the second variable" (Garrett, 1966). Since all the variables included in the study can be measured on the interval scale, the method used to identify the coefficient of correlation is Pearson's product moment method. The computed value of coefficient of correlation is called as Pearson's Product moment coefficient of correlation and it is represented by the symbol 'r'. The formula used for the calculation of correlation coefficient is

$$r = \frac{N\sum XY - \sum X \sum Y}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]\left[N\sum Y^2 - \left(\sum Y\right)^2\right]}} \quad \text{(Garrett, 1966)}$$

Where

$\sum X$ = Sum of the X scores

$\sum Y$ = Sum of the Y scores

$\sum X^2$ = Sum of the squared X scores

$\sum Y^2$ = Sum of the squared Y scores

$\sum XY$ = Sum of the products of paired X and Y scores

N = Number of paired scores

According to Garrett (1966) the following criteria are used for verbally interpreting the degree of relationship between the variables.

r from 0.00 to + 0.20 : indifferent or negligible relationship

r from + 0.20 to & 0.40 : low or slight relation

r from + 0.40 to + 0.70 : substantial or marked relationship

r from + 0.70 to + 1.00 : High to very high relationship.

This is done by checking whether the t-value obtained by the formula, $t= r\sqrt{N-2}/\sqrt{1-r^2}$, exceeds 1.96 or 2.58, for significance at 0.05 level and 0.01 level respectively. If the r value obtained is significant at 0.01 level, the 0.99 confidence interval of r is estimated using the formula, ($r + 2.58\ SE_R$),

Where,

SE_R, the Standard Error of r,

'r' being the obtained Coefficient Of Correlation.

If the r value obtained is significant only at 0.05 level or not significant, the 0.95 confidence interval of r is estimated using the formula, ($r + 1.96\ SEr$),

Where,

SE_R = the standard error of r,

r = the obtained Coefficient of Correlation.

The formula for computing percentage variance shared between the variables is r^2 X 100. The obtained value indicates the percentage of variation of the Criterion Variable that can be attributed to the variation in the Predictor Variable (Fox, 1969).

Multiple Regression Analysis

"Multiple regression analysis is a method for studying the effects and the magnitudes of the effects of more than one Predictor Variable on one Criterion Variable using principles of correlation and regression" (Kerlinger, 1973). Regression predicts the individual and combined contribution of Predictor Variables on Criterion Variable and check whether the data is 'fit' to the model developed. Multiple Regression was done using step wise method in which all the predictor Variables were entered simultaneously. All statistical analysis has been done using SPSS for windows version 16.

Stepwise Multiple Regression Analysis.

In SPSS different procedures like stepwise, enter, backward and forward approach are used in regression analysis. Stepwise Multiple Regression Analysis has been used in the present study. This is a statistical technique used to select the set of variables that best predicts the Criterion Variable and that eliminates superfluous Predictor Variables. The input data for stepwise regression analysis are means and standard deviations of all the variables (criterion as well as predictor) and the correlation matrix of the Criterion Variable with the Predictor Variables. As the first step it searches for the best predictor of the Criterion Variable, add to the prediction equation. The Predictor Variable having highest correlation is selected as the best predictor and the Predictor Variable having the next highest partial correlation is entered in step-2, but low correlation with the best predictor identified at this step. If the percentage variance contributed by the two variables is considerably higher than the percentage variance contributed by the first variable, it suggests that the second entered variable is also a significant predictor. If the R also has increased considerably from the previous R, this is further evidence that the predictor variable second entered is significant in predicting the criterion variable. In the third step, the predictor having next higher correlation with criterion variable is emerged but low correlation with two of the existing predictors already selected. Proceeding like this if we find that, in any of the succeeding step, neither the percentage variance, nor the R has increased, it is an indication that the variable entered last is not a significant predictor of the criterion variable (Cohen & Manion, 1989).

For all the models developed, the measures like Total Mean Sum of Square Variance, Regression Mean Sum of Square Variance, Residual Mean Sum of Square Variance, Percentage of variance due to the variable entered, 'B' weight, Regression coefficient (β) and the respective standard error were calculated.

The regression model has been represented by the general regression equation:

$$Y = b1\ X1 + b2\ X2 + b3\ X3 \ldots\ldots\ldots\ldots + C$$

Where:

Y represents the predicted score for Criterion Variable, X_1, X_2, X_3 ……..are raw scores on the Predictor Variables under study, b1, b2, b3,…. show regression weights applied to the predictor variables to form the linear combination and 'C' is the constant term. The significance of the variance to the Criterion Variable has been judged by using F-test.

The value of F can be calculated by the formula; $F = (R_n^2 - R_n^2 - 1)\ (N-n-1)/1-R_n^2$

Where,

R_n^2 = Square of multiple correlation after adding nth variable.

$R_n^2 - 1$ = Square of multiple correlation before adding nth variable.

N = Total number of students.

The F-value enables us to see whether the Regressor (Predictor Variable entered) is significant or not; i.e., if the obtained F-value exceeds the tabled value of 'F' for a particular level of significance and for the relevant degrees of freedom.

The Coefficient of Determination (R^2) and the Multiple Correlation Coefficient (R) between the Criterion and Predictor Variables is computed in terms of β and r. The formula for this is,

$$R_{1}^{2}{}_{(2,3....n)} = \beta_{12.34....n}\, r_{12} + \beta_{13.24....n}\, r_{13} + \beta_{14.23....n}\, r_{14} + ... + \beta_{1n.234\,....\,(n-1)}\, r_{1n}$$

Where, '1' stands for the criterion variable and 2, 3...... for the significant predictor variables as found by regression analysis.

R^2, the Coefficient of Determination also enable us to work out the relative efficiency of each significant predictor variable in predicting the criterion variable. The term $\beta.1234....nr_{12}$ will give the efficiency of the predictor variable 2. The term β 1324...n r_{13} will give the efficiency of the predictor variable 3 and so on.

CHAPTER 4

Analysis and Interpretation

- *Preliminary Analysis*
  - *Important Statistical Constants*
- *Major Analysis - I*
  - *Percentage Analysis*
  - *Mean Difference Analysis*
- *Major Analysis –II*
  - *Multiple Regression Analysis*

The present study is designed to find out the influence of Metacognitive Awareness, Goal Orientation, and Learning Styles on Process Skills in Chemistry of Secondary School Students. In the analysis of the present data, the first phase deals with Preliminary Analysis to find out the relevant statistical constants such as Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis for identifying the nature of distributions of Predictor Variables and Criterion Variables selected for the study. The second phase of Analysis deals with results of major statistical techniques such as Percentage Analysis, Mean Difference Analysis and Stepwise Multiple Regression analysis. In this, Percentage Analysis was used to find out the level of Metacognitive Awareness among Secondary School Students for Total and relevant subsamples. Mean Difference Analysis was used for investigating the significant differences in the mean scores of Predictor and Criterion Variables based on Gender, Locale and Type of Management of the Institution, and Multiple Regression Analysis; for explaining the degree of variability in Criterion Variables by means of one or more of the Predictor Variables. The statistical analysis was done on the background of the objectives formulated for the study. Based on the results of statistical processing of data, the investigator tested the hypotheses formulated for the study.

The results of the whole analysis done for the present study are described under the following heads:

Preliminary Analysis

Important Statistical Constant

Major Analysis - I

Percentage Analysis

Mean Difference Analysis

Major Analysis - II

Multiple Regression Analysis

Preliminary Analysis

The essential descriptive statistics such as Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis which serve as inputs for further inferential analysis of data, were calculated as the first stage of analysis and presented in this section of the report.

Important Statistical Constants

For the present study, the Preliminary Analysis was carried out to understand the basic properties of the Predictor Variables namely; Metacognitive Awareness, Goal Orientation and Learning Styles and of the Criterion Variables, Basic Process Skills and Integrated Process Skills in Chemistry. Preliminary analysis was carried out for the Total Sample and the sub samples based on Gender, Locale and Type of Management of the Institution. The analysis was taken up with a view that the findings will help to make more suitable interpretation of statistical indices of the study. Also, the assumptions made in the use of Product Moment Coefficient of Correlation and Regression Equation (Garrett, 1979) necessitates that distributions of the variables should be normal, or at least, not badly skewed.

The score distribution of the Predictor Variables and Criterion Variables were studied for their normality. For this, important statistical constants were calculated separately for Total Sample and subsamples based on Gender, Locale and Type of Management of the Institution. The important statistical indices namely Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis of the score distribution for Metacognitive Awareness, Goal Orientation, Learning Styles, Basic Process Skills in Chemistry, and Integrated Process Skills in Chemistry were calculated and are presented in Tables 18 and 19 respectively.

Table 18

Important Statistical Constants for the Score Distribution of Metacognitive Awareness for the Total Sample and the Subsamples Based on Gender, Locale and Type of Management of the Institution

Variable	Sample		Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
Metacognitive Awareness (MA)	Gender	Male	75.81	77.00	76.00	10.11	-0.70	1.38
		Female	76.18	77.00	78.00	10.03	-0.40	0.02
	Locale	Urban	75.82	77.00	78.00	10.01	-0.34	0.08
		Rural	76.22	77.00	75.00	10.11	-0.70	1.11
	Type of Management	Government	76.46	78.00	83.00	10.06	-0.30	-0.27
		Aided	75.73	77.00	78.00	10.06	-0.69	1.18
		Total	76.03	77.00	78.00	10.06	-0.53	0.60

Table 18 reveals that the Mean (76.03), Median (77.00), and Mode (78.00) of Metacognitive Awareness of Secondary School Students for Total Sample and subsample are nearly equal. The Standard Deviation (10.06) indicates that the scores of Metacognitive Awareness do not deviate much from the mean. The indices of Skewness (-0.53) and Kurtosis (0.60) for Total Sample indicate slightly negatively skewed, leptokurtic distribution of Metacognitive Awareness of Secondary School Students.

Table 19

Important Statistical Constants for the Score Distribution of Goal Orientation (Mastery, Performance-Approach and Performance-Avoidance Goal Orientation) for the Total Sample and the Subsamples Based on Gender, Locale and Type of Management of the Institution

Goal Orientation	Sample		Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
Mastery Goal Orientation (MGO)	Gender	Male	72.60	72.00	73.00	8.04	-3.29	0.29
		Female	71.21	72.00	71.00	8.69	-3.66	0.28
	Locale	Urban	70.92	72.00	71.00	8.80	-4.20	0.32
		Rural	71.79	72.00	72.00	8.04	-2.71	0.24
	Type of Management	Government	70.96	72.00	69.00	10.84	-4.03	0.24
		Aided	71.67	72.00	71.00	6.21	0.15	0.66
	Total		71.37	72.00	71.00	8.42	-3.53	0.29
Performance –Approach Orientation (PAPGO)	Gender	Male	71.60	72.00	74.00	8.07	-0.30	0.27
		Female	73.78	73.00	73.00	8.09	0.01	-0.12
	Locale	Urban	73.96	74.00	75.00	8.32	-0.07	-0.15
		Rural	73.42	73.00	68.00	7.84	-0.17	0.21
	Type of Management	Government	73.92	74.00	74.00	8.30	-0.11	-0.04
		Aided	73.51	74.00	78.00	7.92	-0.12	0.08
	Total		73.68	74.00	68.00	8.08	-0.11	0.02
Performance-Avoidance Orientation (PAVGO)	Gender	Male	67.99	69.00	71.00	12.01	-0.21	0.04
		Female	67.08	69.00	69.00	10.63	-0.22	0.50
	Locale	Urban	67.50	69.00	69.00	11.73	-0.23	0.42
		Rural	67.43	69.00	63.00	10.76	-0.16	0.07
	Type of Management	Government	67.61	69.00	69.00	11.63	-0.38	0.61
		Aided	67.36	69.00	69.00	10.96	-0.06	0.00
	Total		67.46	69.00	69.00	11.23	-0.20	0.28

Table 19 shows that the Mean (71.37), Median (72.00), and Mode (71.00) of Mastery Goal Orientation of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (8.42) score indicates that the scores of Mastery Goal Orientation do not deviate much from the mean.The indices of Skewness (-3.53) and Kurtosis (0.29) indicate slightly negatively skewed, leptokurtic distribution for Mastery Goal Orientation of Secondary School Students.

Table 19 points that the Mean (73.68), Median (74.00), and Mode (68.00) of Performance-Approach Goal Orientation of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (8.08) score indicates that the scores of Performance-Approach Goal Orientation do not deviate much from the mean. The indices of Skewness (-0.11) and Kurtosis (0.02) indicate slightly negatively skewed, mesokurtic distribution for Performance-Approach Goal Orientation of Secondary School Students.

As per Table 19, the Mean (67.46), Median (69.00), and Mode (69.00) of Performance-Avoidance Goal Orientation of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (11.23) score indicates that the scores of Performance-Avoidance Goal Orientation do not deviate much from the mean. The indices of Skewness (-0.20) and Kurtosis (0.28) indicate slightly negatively skewed, mesokurtic distribution for Performance-Avoidance Goal Orientation of Secondary School Students.

Table 20

Important Statistical Constants for the Score Distribution of Learning Styles (Visual, Auditory and Kinesthetic Styles) of the Total Sample and the Subsamples Based on Gender, Locale and Type of Management of the Institution

Learning Styles	Sample		Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
Visual Learning Style (VLS)	Gender	Male	75.46	76.00	71.00	8.21	-0.22	-0.35
		Female	77.15	79.00	83.00	8.73	-0.52	0.16
	Locale	Urban	76.43	76.50	79.00	8.63	-0.44	-0.04
		Rural	76.45	76.00	83.00	8.48	-0.33	-0.12
	Type of Management	Government	75.79	76.00	83.00	8.43	-0.48	0.12
		Aided	76.89	78.00	83.00	8.61	-0.34	-0.24
		Total	76.44	76.00	77.00	8.55	-0.38	-0.08
Auditory Learning Style (ALS)	Gender	Male	68.81	69.00	67.00	6.88	0.12	0.69
		Female	67.98	67.50	65.00	7.77	-0.97	0.98
	Locale	Urban	68.40	69.00	65.00	7.72	-1.34	0.12
		Rural	68.26	67.50	65.00	7.13	0.19	0.36
	Type of Management	Government	68.40	69.00	67.00	7.14	0.10	0.50
		Aided	68.27	69.00	65.00	7.60	-1.04	0.10
		Total	68.33	69.00	65.00	7.42	-0.63	0.71
Kinesthetic Learning Style (KLS)	Gender	Male	68.84	68.00	73.00	8.21	0.36	0.53
		Female	68.80	68.00	67.00	8.55	0.39	1.22
	Locale	Urban	69.27	68.00	67.00	8.65	0.42	0.52
		Rural	68.40	68.00	67.00	8.17	0.31	1.42
	Type of Management	Government	69.07	68.00	67.00	9.02	0.21	1.06
		Aided	68.64	68.00	67.00	7.96	0.53	0.74
		Total	69.82	68.80	67.00	8.41	0.38	0.95

Table 20 points that the Mean (76.44), Median (76.00), and Mode (77.00) of Visual Learning Style of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (8.55) score indicates that the scores of Visual Learning Style do not deviate much from the mean.The indices of Skewness (-0.38) and Kurtosis (-0.08) indicate slightly negatively skewed, platykurtic distribution for Visual Learning Style of Secondary School Students.

Table 20 reveals that the Mean (68.33), Median (69.00), and Mode (65.00) of Auditory Learning Style of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (7.42) score indicates that the scores of Auditory Learning Style do not deviate much from the mean.The indices of Skewness (-0.63) and Kurtosis (0.71) indicate slightly negatively skewed, leptokurtic distribution for Auditory Learning Style of Secondary School Students.

Table 20 shows that the Mean (69.82), Median (68.00), and Mode (67.00) of Kinesthetic Learning Style of Secondary School Students for Total Sample and subsample are nearly equal. The Standard Deviation (8.41) score indicates that the scores of Kinesthetic Learning Style do not deviate much from the mean.The indices of Skewness (0.38) and Kurtosis (0.95) indicate slightly positively skewed, leptokurtic distribution for Kinesthetic Learning Style of Secondary School Students.

Table 21

Important Statistical Constants for the Score Distribution of the Criterion Variables; Basic and Integrated Process Skills in Chemistry of the Total Sample and the Subsamples Based on Gender, Locale and Type of Management of the Institution

Variables	Sample		Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
Basic Process Skills in Chemistry (BPS)	Gender	Male	74.54	78.00	78.00	15.53	-0.84	-0.25
		Female	73.13	78.00	78.00	16.50	-0.73	-0.43
	Locale	Urban	72.83	78.00	78.00	16.96	-0.68	-0.61
		Rural	74.54	78.00	78.00	15.24	-0.87	-0.08
	Type of Management	Government	72.77	78.00	78.00	16.31	0.62	-0.38
		Aided	74.38	78.00	78.00	15.94	-0.79	-0.34
		Total	73.72	78.00	78.00	16.10	-0.78	-0.36
Integrated Process Skills in Chemistry (IPS)	Gender	Male	67.36	72.00	72.00	16.86	-0.57	-0.54
		Female	67.59	72.00	72.00	17.56	-0.48	-0.80
	Locale	Urban	67.01	71.00	84.00	18.42	-0.44	-0.92
		Rural	67.93	72.00	72.00	16.13	-0.59	-0.47
	Type of Management	Government	67.55	72.00	72.00	17.40	-0.54	-0.61
		Aided	67.45	72.00	72.00	17.19	-0.50	-0.76
		Total	67.49	72.00	72.00	17.26	-0.52	-0.70

Table 21 shows that the Mean (73.72), Median (78.00), and Mode (78.00) of Basic Process Skills in Chemistry of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation (16.10) score indicates that the scores of Basic Process Skills in Chemistry do not deviate much from the mean. The indices of Skewness (-0.78) and Kurtosis (-0.36) indicate slightly negatively skewed, platykurtic distribution for Basic Process Skills in Chemistry of Secondary School Students.

As per Table 21, the Mean (67.49), Median (72.00), and Mode (72.00) of Integrated Process Skills in Chemistry of Secondary School Students for Total Sample and subsamples are nearly equal. The Standard Deviation

(17.26) score indicates that the scores of Integrated Process Skills in Chemistry do not deviate much from the mean. The indices of Skewness (-0.52) and Kurtosis (-0.70) indicate slightly negatively skewed, platykurtic distribution for Integrated Process Skills in Chemistry of Secondary School Students.

The indices of the distribution of scores of the Predictor Variables and the Criterion Variables were studied, which were found to be nearly normal and is not badly skewed. In addition to this, the distributions were further examined using P-P plot (Probability-Probability plot). This graph plots the cumulative probability of a variable against the cumulative probability of normal distribution. What this means is that the data are ranked and sorted. Then for each rank the corresponding z-score is calculated. This is the expected value that the score should have in a normal distribution. Next, the score itself is converted to a z-score. The actual z-score is plotted against the expected Z score. The observed cumulative probability is represented in X axis and expected cumulative probability is presented in the Y axis. If the data are normally distributed then the actual z-score will be the same as the expected z-score and will get a straight diagonal line. If values fall on the diagonal of the plot then the variable is normally distributed, but deviations from the diagonal show deviations from normality. The P-P plots of Metacognitive Awareness, Goal Orientation (Mastery Goal Orientation, Performance-Approach Goal Orientation, and Performance-Avoidance Goal Orientation), Learning Styles (Visual Learning Style, Auditory Learning Style, and Kinesthetic Learning Style), Basic and Integrated Process Skills in

Chemistry for the Total Sample are presented as Figures 4, 5, 6 and 7 respectively.

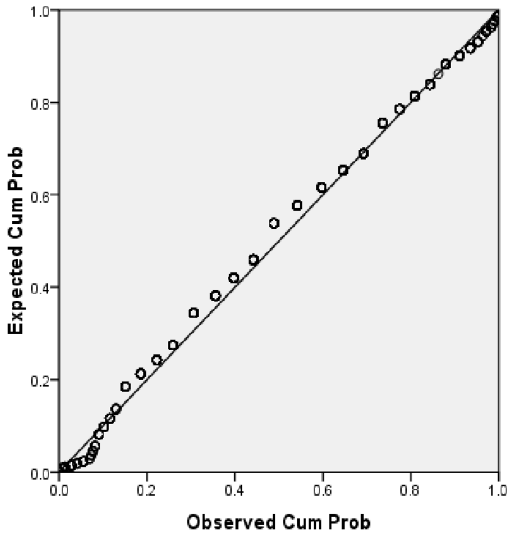


Figure 4. Normal P-P Plot of Metacognitive Awareness for Total Sample

A visual examination of the data of Metacognitive Awareness using P-P plots revealed that there are only slight deviations of observed cumulative probability from the diagonals. It revealed that the distribution obtained for Metacognitive Awareness is approximated to normality. The near normal distribution obtained suggests that the sample chosen for the study is fairly representative of the population.

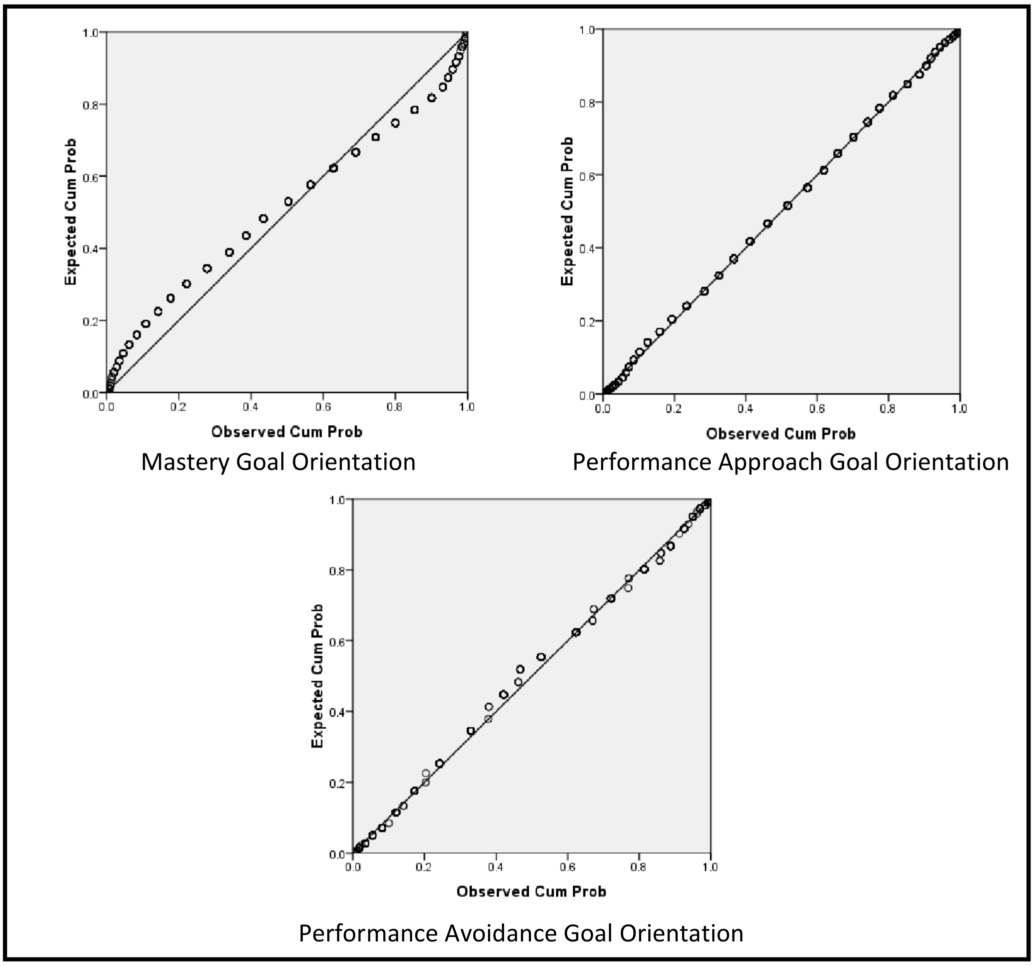


Figure 5. Normal P-P Plot of Mastery, Performance-Approach and Performance-Avoidance Goal Orientations for Total Sample

A visual examination of the data of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation using P-P plots revealed that there are only slight deviations of observed cumulative probability from the diagonals. It revealed that the distribution obtained for Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation is approximated to normality. The near normal distribution obtained suggests that the sample chosen for the study is fairly representative of the population.

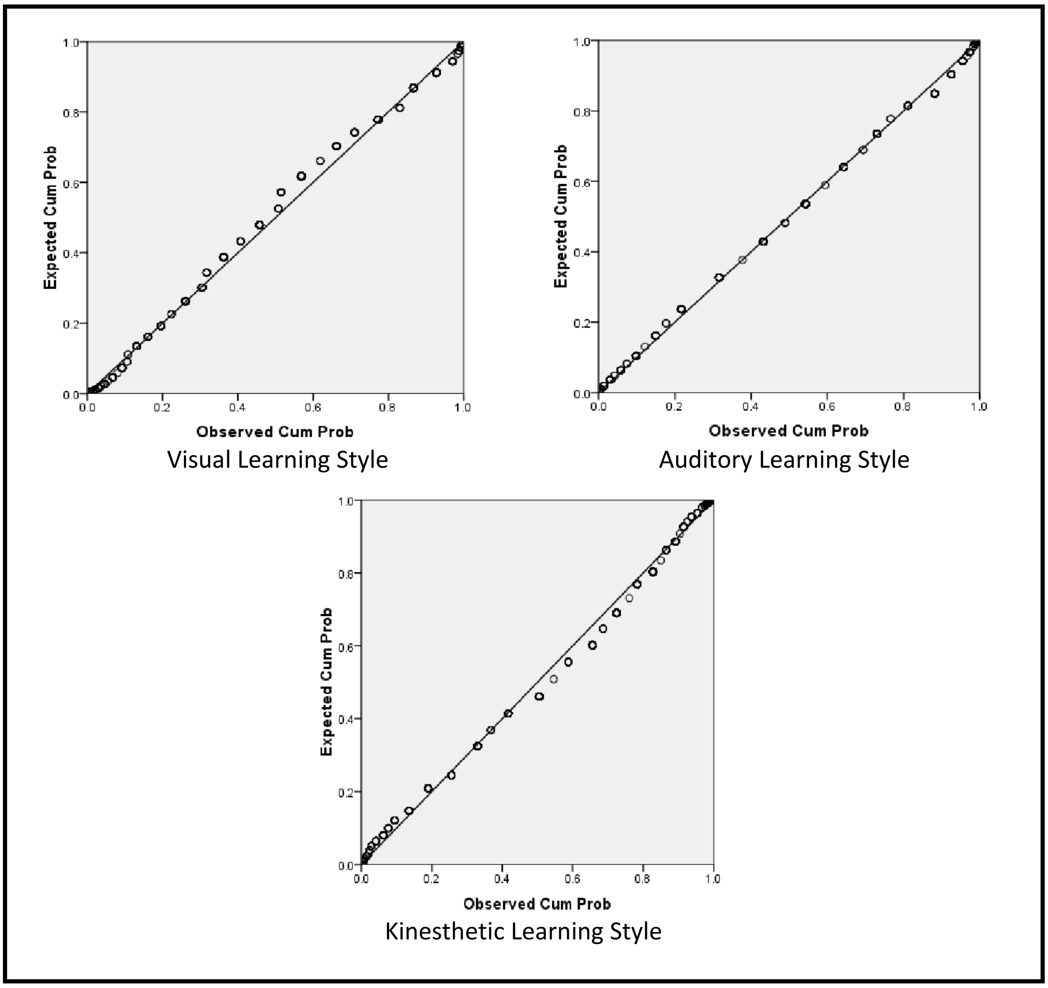


Figure 6. Normal P – P Plot of Visual, Auditory and Kinesthetic Learning Styles for Total Sample

A visual examination of the data of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style using P-P plots revealed that there are only slight deviations of observed cumulative probability from the diagonals. It revealed that the distribution obtained for Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style is approximated to normality. The near normal distribution obtained suggests that the sample chosen for the study is fairly representative of the population.

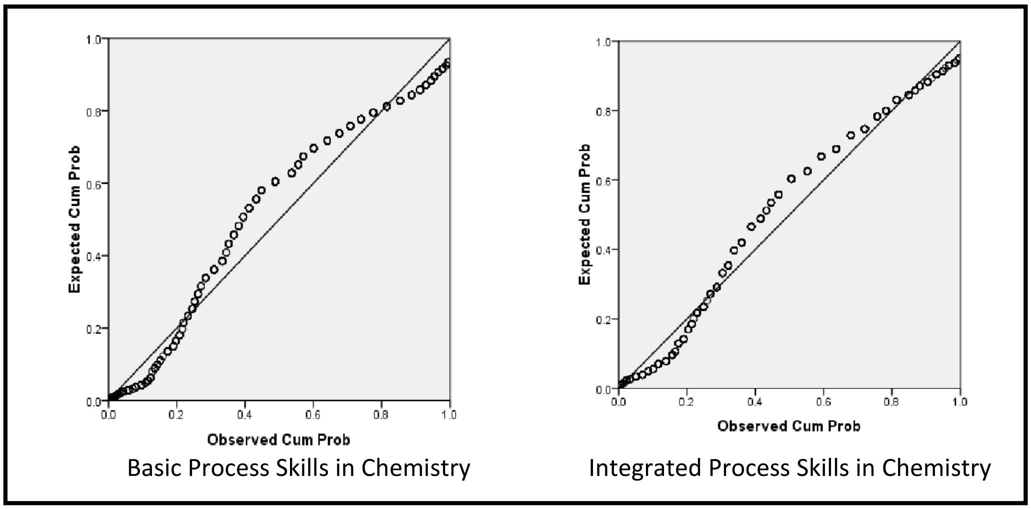


Figure 7. Normal P-P Plot of Basic and Integrated Process Skills in Chemistry for Total Sample

A Visual examination of the data of Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry using P-P plots revealed that there occurs some deviations of observed cumulative probability from the diagonals. It revealed that the distribution obtained for Basic and Integrated Process Skills in Chemistry is approximated to normality. The near normal distribution obtained suggests that the sample chosen for the study is fairly representative of the population.

From the preliminary analysis, it can be concluded that the Predictor Variables; Metacognitive Awareness, Goal Orientation and Learning Styles and the Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry are satisfying the properties of normality. Hence the investigator carried out the following major analysis for the data.

Major Analysis - I

In this section of the chapter, the statistical techniques such as Percentage Analysis and Mean Difference Analysis are used to study the level of Metacognitive Awareness and for the Comparison of the Predictor

Variables and Criterion Variables in terms of sub samples based on Gender, Locale and Type of Management of Institution. The results obtained in this analysis are described in detail under the following sections.

Percentage Analysis

Simple Percentage Analysis calculation was used to assess the level of Metacognitive Awareness for the Total Sample and the subsamples based on Gender, Locale and Type of Management of the Institution. Details of the Percentage Analysis done for the Total Sample and the subsamples based on Gender, Locale and Type of Management of the Institution are presented in this section.

Levels of Metacognitive Awareness for the Total Sample and the subsamples Based on Gender, Locale and Type of Management of the Institution.

An objective of the study was to find out the level of Metacognitive Awareness of Secondary school students for the Total sample and sub samples formed on the basis of Gender, Locale and Type of Management of the Institution. The classification of the sample in to High Metacognitive Awareness group (HMA), Moderate Metacognitive Awareness group (MMA), and Low Metacognitive Awareness group (LMA) were done on the basis of conventional procedure of sigma (σ) distance from the Mean. Students having a score with $M+\sigma$ and above (138 and above) in Metacognitive Awareness were treated as HMA group, those with score $M-\sigma$ and below (106 and below) were included in LMA group and those having score in between $M + \sigma$ and M

- σ (between 138 & 106) were treated as MMA group. Simple percentage calculation was used to determine the number of students in each group. Percentage of Metacognitive Awareness under High Metacognitive Awareness (HMA), Moderate Metacognitive Awareness (MMA) and Low Metacognitive Awareness (LMA) levels are presented in the Table 22.

Table 22

Data and Results of Level of Metacognitive Awareness for the Total Sample and the Subsamples Based on Gender, Locale and Type of Management of the Institution

Sample		Mean	SD	N	Level of Metacognitive Awareness					
					HMA		MMA		LMA	
					N	%	N	%	N	%
Total		76.03	10.06	980	204	21	657	67	119	12
Gender	Male	75.81	10.11	412	81	20	284	69	47	11
	Female	76.18	10.03	568	123	22	373	66	72	12
Locale	Urban	75.82	10.01	470	92	20	321	68	57	12
	Rural	76.22	10.11	510	112	22	336	66	62	12
Type of Management	Government	76.46	10.06	401	89	22	262	65	50	13
	Aided	75.73	10.06	579	115	20	395	68	69	12

Levels of Metacognitive Awareness for the Total Sample.

Table 22 shows that, out of 980 Secondary School Students, only 204 students (21%) are having High Metacognitive Awareness level (HMA), 657 students (67%) i.e. majority of Secondary School Students are having a Moderate level of Metacognitive Awareness (MMA) and 119 students (12%) are having Low Metacognitive Awareness (LMA). So for the Total sample, ***majority of the Secondary School Students are having Moderate level of Metacognitive Awareness.*** The Mean value of Metacognitive Awareness for Total sample is 76.03 and the Standard Deviation is 10.06.

Levels of Metacognitive Awareness for the subsample Based on Gender.

Table 22 reveals that for the subsample based on Gender; out of 412 Male students, only 81 students (20%) are with HMA, 284 students (69%) are having MMA and 47 are (11%) with LMA. In the case of Female Secondary School Students; out of 568 members, 123 students (22%) are with HMA, 373 students (66%) are with MMA and 72 students (12%) are with LMA. So for the sub sample based on Gender, ***most of the Male and Female*** Secondary School Students ***are coming under Moderate Metacognitive Group*** and the percentage of Female students with High Metacognitive Awareness level is relatively higher than Male students. The Mean scores of Metacognitive Awareness for Male students (*M* = 75.8, *SD* = 10.11) is less than that of the Female students (*M* = 76.18, *SD* = 10.03).

Levels of Metacognitive Awareness for the subsample Based on Locale.

Table 22 points that for the subsample based on Locale of the Institution, the data reveals that, out of 470 Secondary School Students from Urban area only 92 students (20%) are having HMA, 321 students (68%) are having MMA and 57 students (12%) are having LMA. In case of students from Rural area, out of 510 students, 112 students (22%) are coming under the HMA group, 336 students (66%) belong to MMA group and 62 (12%) are included in LMA group. Hence, the result of percentage calculation shows that the ***majority*** of the Secondary School Students ***from Urban and Rural area are coming under Moderate Metacognitive Group*** than High and Low

Metacognitive Awareness group. The percentage of students with High Metacognitive Awareness is comparatively higher for students from Rural than Urban area. The Mean scores of Metacognitive Awareness for Urban sample (*M* = 75.82, *SD* = 10.01) is less than that of the Rural students (*M* = 76.22, *SD* = 10.11).

Levels of Metacognitive Awareness for the subsample Based on Type of Management of the Institution.

The result of percentage calculation of the subsample based on Type of Management of the Institution shows that, out of 401 Secondary School Students from Government sector; only 89 students (22%) are included in HMA group, 262 students (65%) are with Moderate Metacognitive Awareness level and 50 students (13%) are with Low Metacognitive Awareness. For the 579 Secondary School Students from Aided sector, 115 students (20%) are included in HMA level, 395 students (68%) are having Moderate Metacognitive Awareness and 69 students (12%) are included in LMA group. So ***majority of the Government and Aided*** Secondary School Students are having ***Moderate Metacognitive Awareness*** and the percentage of students with high level of Metacognitive Awareness is more for Government sector than Aided sector. The Mean Scores of Metacognitive Awareness for Government students (*M* =76.46, *SD* = 10.06) is less than that of the Rural students (*M* = 75.03, *SD* = 10.06).

Hence from the result of Percentage Analysis, it can be concluded that ***most of the Secondary School Students are having a Moderate level of Metacognitive Awareness*** for the Total Sample and the subsamples based on Gender, Locale and Type of Management of the Institution.

The Mean scores of Metacognitive Awareness revealed that ***Female students are better in Metacognitive Awareness*** than their counterparts.

Similarly ***Rural students are high in Metacognitive Awareness than Urban students*** and ***Government students are more metacognitively aware than Aided students.***

Since Metacognition is the base of all knowledge, it develops favourable attitudes and skills among secondary level students. As it is a precursor of efficient usage of the ones' own cognitive potential, it enables an individual to be a successful learner. So, Secondary School students with high Metacognitive Awareness may have better academic success.

Extent of Goal Orientation of Secondary School Students for the Total Sample and the sub samples Based on Gender, Locale and Type of Management of the Institution

The Second objective of the study was to find out the type of Goal Orientation adopted by students in various learning situations. The Goal Orientation of Secondary School Students is mainly represented by Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), and Performance-Avoidance Goal Orientation (PAVGO). Calculation of Mean and Standard Deviation was used to identify the type of Goal Orientation adopted by Secondary School Students for the Total Sample and the subsamples based on Gender, Locale and Type of Management of the Institution. The results of the analysis are presented in Table 23.

Table 23

Data and Results of the Extent of Goal Orientation of Secondary School Students for the Total Sample and Subsamples Based on Gender, Locale and Type of Management of the Institution

Goal Orientation		Total	Gender		Locale		Type of Management	
			Male	Female	Urban	Rural	Govt	Aided
MGO	*M*	71.37	72.60	71.21	70.92	71.79	70.96	71.69
	SD	8.42	8.04	8.69	8.80	8.04	10.84	6.21
PAPGO	*M*	73.68	71.60	73.78	73.96	73.42	73.92	73.51
	SD	8.08	8.07	8.09	8.32	7.84	8.30	7.92
PAVGO	*M*	67.46	67.99	67.08	67.50	67.43	67.61	67.36
	SD	8.08	12.01	10.63	11.73	10.76	11.63	10.96

Extent of Goal Orientation of Secondary School Students for the Total Sample.

Table 23 shows that the Mean scores obtained for the three type of Goal Orientation of Secondary School Students are; Mastery Goal Orientation (*M* = 71.37, *SD* = 8.42), Performance-Approach Goal Orientation (*M* = 73.68, *SD* = 8.08), and Performance-Avoidance Goal Orientation (M = 67.46, *SD* = 8.08). The Mean scores revealed that the ***Secondary School Students are more oriented towards Performance-Approach Goal***, followed by the Mastery Goal Orientation. The least important Goal Orientation of Secondary School Students is Performance-Avoidance Goal.

Extent of Goal Orientation of Secondary School Students for the sub samples Based on Gender.

From Table 23, the Mean scores obtained for three type of Goal Orientation for Male students are; Mastery Goal Orientation (*M* =72.60, *SD* = 8.04), Performance-Approach Goal Orientation (*M* = 71.60, *SD* = 8.07), and

Performance-Avoidance Goal Orientation (*M* = 67.99, *SD* = 12.01). The greater Mean scores associated with ***Male Secondary School Students pointed that they are more oriented towards Mastery Goal***, followed by Performance-Approach Goal Orientation. The lowest Goal exhibited by Male Secondary School Students is Performance-Avoidance Goal.

For Female students, the Mean scores obtained for three type of Goal Orientation are; Mastery Goal Orientation (*M*=71.21, *SD*=8.69), Performance-Approach Goal Orientation (*M* = 73.78, *SD* = 8.09), and Performance-Avoidance Goal Orientation (*M* = 67.08, *SD* = 10.63). It is evident from the Mean scores that ***Female Secondary School Students are more oriented towards Performance-Approach Goal***, followed by Mastery Goal Orientation. The least important Goal Orientation choosed by Secondary School Students is Performance-Avoidance Goal.

Extent of Goal Orientation of Secondary School Students for the sub samples Based on Locale.

As per Table 23, the Mean scores obtained for three type of Goal Orientation for Urban students are; Mastery Goal Orientation (*M* = 70.92, *SD* = 8.80), Performance-Approach Goal Orientation (*M* = 73.96, *SD* = 8.32), and Performance-Avoidance Goal Orientation (*M* = 67.50, *SD* = 11.73). The higher Mean scores pointed that the Secondary School ***Students from Urban area are more oriented towards Performance-Approach Goal***, followed by Mastery Goal Orientation. The least Goal Orientation chosen by Urban Secondary School Students is Performance-Avoidance Goal.

For Rural students, the Mean scores obtained for three type of Goal Orientation are; Mastery Goal Orientation (*M*=71.79, *SD*=8.04), Performance-

Approach Goal Orientation (*M* = 73.42, *SD* = 7.84), and Performance-Avoidance Goal Orientation (*M* = 67.43, *SD* = 10.76). The Mean scores revealed that the ***Rural Secondary School Students are more oriented towards Performance-Approach Goal***, followed by Mastery Goal Orientation. The least important Goal Orientation selected by Rural Secondary School Students is Performance-Avoidance Goal.

Extent of Goal Orientation of Secondary School Students for the sub samples Based on Type of Management of the Institution.

Table 23 reveals that for Government students, the Mean scores obtained for three type of Goal Orientation are; Mastery Goal Orientation (*M* = 70.96, *SD* = 10.84), Performance-Approach Goal Orientation (*M* = 73.92, *SD* = 8.30), and Performance-Avoidance Goal Orientation (*M* = 67.61, *SD* = 11.63). The Mean scores indicated that the ***Government Secondary School Students are more oriented towards Performance-Approach Goal***, followed by Mastery Goal. The least important Goal Orientation adopted by Government Secondary School Students are Performance-Avoidance Goal.

For Aided School students, the Mean value obtained for three type of Goal Orientation are; Mastery Goal Orientation (*M* = 71.69, *SD* = 6.21), Performance-Approach Goal Orientation (*M* = 73.51, *SD* = 7.92), and Performance-Avoidance Goal Orientation (*M* = 67.36, *SD* = 10.96). The Mean scores revealed that the ***Aided Secondary School Students are more oriented towards Performance-Approach Goal***, followed by Mastery Goal. The least Goal oriented by Aided Secondary School Students is Performance-Avoidance Goal.

Hence, Secondary School Students are more oriented towards Performance-Approach Goal Orientation; except for Male students, who shows a difference in their Goal Orientation pattern. Male students are more oriented towards Mastery Goals rather than PAPGO and PAVGO. As the Performance-Approach Goal is more associated with demonstration of abilities in comparison to others, it can be concluded that ***Secondary School Students are more competitive in nature and concentrated to improve their grades or marks***. But ***Male students are motivated to Mastery Goals*** which help them for the improvement of their personal skills and abilities. Mastery Goal Oriented learners work for their own sake, attempt challenging task and regard failure as the part of learning; whereas Performance Orinetd learners also give emphasis on the self development but in comparison to others' performance.

Therefore, Goal Orientation is an important diterminant of academic success of secondary school students. Hence the process of teaching-learning must be directed to the development of adaptive goals like Mastery Goal than less adaptive goals like Performance Goals.

Extent of Learning Style Preferences of Secondary School Students for the Total Sample and the sub samples Based on Gender, Locale and Type of Management of the Institution

The third objective of the study was to find out the Learning Style Preferences of Secondary School Students. The Learning Styles of Secondary School Students are mainly represented by Visual Learning Style (VLS), Auditory Learning Style (ALS), and Kinesthetic Learning Style (KLS). Calculation of Mean and Standard Deviation was used to identify the Learning Style Preferences of Secondary School Students for the Total

Sample and the subsamples based on Gender, Locale and Type of Management of the Institution. Results of the analysis are presented in Table 24.

Table 24

Data and Results of the Extent of Learning Style Preference of Secondary School Students for the Total and Subsamples Based on Gender, Locale and Type of Management of the Institution

Learning Styles		Total	Gender		Locale		Type of Management	
			Male	Female	Urban	Rural	Govt	Aided
VLS	*M*	76.44	75.46	77.15	76.43	76.45	75.79	76.89
	SD	8.55	8.21	8.73	8.63	8.48	8.43	8.61
ALS	*M*	68.33	68.81	67.12	68.40	68.26	68.40	68.27
	SD	7.42	6.88	7.12	7.72	7.13	7.14	7.60
KLS	*M*	69.82	68.84	68.80	69.27	68.40	69.07	68.64
	SD	8.41	8.21	8.55	8.65	8.17	9.02	7.96

Extent of Learning Style Preferences of Secondary School Students for the Total Sample.

Table 24 shows that the mean scores obtained for Learning Styles of Secondary School Students are; Visual Learning Style (*M* = 76.44, *SD* = 8.55), Auditory Learning Style (*M* = 68.33, *SD* = 7.42), and Kinesthetic Learning Style (*M* = 69.82, *SD* = 8.41). The mean scores revealed that the ***most preferred Learning Style of Secondary School Students is Visual Learning Style***, followed by Kinesthetic Learning Style. The least preferred Learning Style of Secondary School Students is Auditory Learning Style.

Extent of Learning Style Preferences of Secondary School Students for the Sub Sample Based on Gender.

It is evident from Table 24, for ***Male*** students, the Mean scores obtained for Learning Styles are; Visual Learning Style (*M* = 75.46, *SD* = 8.21), Auditory Learning Style (*M* = 68.81, *SD* = 6.88), and Kinesthetic Learning Style (*M* = 68.84, *SD* = 8.21). The Mean scores revealed that the ***most preferred Learning Style of Male Secondary School Students is Visual Learning Style*** and they have equal preference for Auditory and Kinesthetic Learning Styles.

For ***Female*** students, the Mean scores obtained for Learning Styles are such as; Visual Learning Style (*M* = 77.15, *SD* = 8.73), Auditory Learning Style (*M* = 67.12, *SD* = 7.12), and Kinesthetic Learning Style (*M* = 68.80, *SD* = 8.55). The Mean scores revealed that ***the most preferred Learning Style of Female Secondary School Students is Visual Learning Style***, followed by Kinesthetic Learning Style. The least preferred Learning Style of Female students are Auditory Learning Style.

Extent of Learning Style Preferences of Secondary School Students for the Sub Samples Based on Locale.

As per Table 24, for ***Urban*** students, the Mean scores obtained for Learning Styles are such as; Visual Learning Style (*M* = 76.43, *SD* = 8.63), Auditory Learning Style (*M* = 68.40, *SD* = 7.72), and Kinesthetic Learning Style (*M* = 69.27, *SD* = 8.65). It is clear form the Mean scores that the ***most preferred Learning Style of Urban Secondary School Students is Visual Learning Style,*** followed by Kinesthetic Learning Style. The least preferred Learning Style is Auditory Learning Style.

For ***Rural*** students, the Mean scores obtained for Learning Styles are such as; Visual Learning Style (*M* = 76.45, *SD* = 8.48), Auditory Learning Style (*M* = 68.26, *SD* = 7.13), and Kinesthetic Learning Style (*M* = 68.40, *SD* = 8.17). The Mean scores implied that ***the most preferred Learning Style of Rural Secondary School Students is Visual Learning Style*** and they have similar preference for Auditory and Kinesthetic Learning Styles.

Extent of Learning Style Preferences of Secondary School Students for the sub samples Based on Type of Management of the Institution.

Table 24 points that, for ***Government*** students, the Mean scores obtained for Learning Styles are such as; Visual Learning Style (*M* = 75.79, *SD* = 8.43), Auditory Learning Style (*M* = 68.40, *SD* = 7.14), and Kinesthetic Learning Style (*M* = 69.07, *SD* = 9.02). It is evident from the Mean scores that the ***most preferred Learning Style of Government Secondary School Students is Visual Learning Style***, followed by Kinesthetic Learning Style. The least preferred Learning Style of Government students is Auditory Learning Style.

For ***Aided*** students the Mean scores obtained for Learning Styles are such as; Visual Learning Style (*M* = 76.89, *SD* = 8.61), Auditory Learning Style (*M* = 68.27, *SD* = 7.60), and Kinesthetic Learning Style (*M* = 68.64, *SD* = 7.96). The Mean scores implied that ***the most preferred Learning Style of Aided Secondary School Students is Visual Learning Style***, followed by Kinesthetic Learning Style. The least preferred Learning Style of Aided students' is Auditory Learning Style.

In brief, it can be said that the ***most preferred Learning Style of Secondary School Students for the Total and the relevant subsamples are***

Visual Learning Style and the ***least preferred is Auditory Style of learning***. As Visual and Kinesthetic Learning Styles are student centred learning approaches, it considerably foster their learning outcomes compared to Auditory Style of Learning.

Hence, to a great extend, the identification and proper selection of Learning Styles for Secondary School Students will be beneficial for their scholastic/academic improvement. According to Chiya (2003), recognizing the weaknesses of their own styles and the strengths of other Learning Styles is important and many studies highlight the importance of learning styles as being not only necessary, but also important for individuals in academic settings. Therefor secondary school teachers should understand learners' preferences with regard to Learning Styles and can provide differentiated instruction to enhance their performance.

Mean Difference Analysis

Comparison of Mean scores were carried out to test whether there exists any significant difference between the Mean scores of the Predictor Variables; Metacognitive Awareness and its Levels (HMA, MMA, & LMA), Goal Orientation (MGO, PAPGO, & PAVGO), and Learning Styles (VLS, ALS, & KLS) and for the Criterion variables; Basic Process skills in Chemistry (BPS) and Integrated process Skills (IPS) in Chemistry of Secondary School Students.

For this, Mean and Standard Deviation of the distributions of Predictor Variables and Criterion Variables were calculated for the Total

Sample and the subsamples based on Gender (Male and Female), Locality of the Institution (Rural and Urban) and Type of Management of the Institution (Government and Aided). As all the Subsamples are of large size, formula for large independent sample was used. Mean scores of the distributions of Predictor Variables and Criterion Variables were calculated separately.

Comparison of the Mean Scores of Metacognitive Awareness and its Levels (HMA, MMA, & LMA) based on the subsample Gender.

To find out the Gender wise differences in case of the Predictor Variable namely, Metacognitive Awareness and its Levels such as; High Metacognitive Awareness (HMA), Moderate Metacognitive Awareness (MMA), and Low Metacognitive Awareness (LMA), the data were analysed with the help of t- test and the results are given in Table 25.

Table 25

Data and Results of the Test of Significance of Difference between the Mean Scores of Metacognitive Awareness and its Levels (HMA, MMA, & LMA) for the Sub Sample Based on Gender

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
MA	Male	412	75.81	10.11	0.56^{ns}
	Female	568	76.18	10.03	
HMA	Male	81	87.88	5.01	2.48*
	Female	123	84.35	5.07	
MMA	Male	284	75.32	6.50	0.75^{ns}
	Female	373	75.67	5.26	
LMA	Male	47	57.97	5.21	0.09^{ns}
	Female	72	58.06	4.92	

Note: *indicates p<.05; ns. indicates not significant

Table 25 shows that the critical ratio obtained for the comparison of the Mean scores of Metacognitive Awareness between Male (M = 75.81, SD =

10.11) and Female (*M* = 76.18, *SD* = 10.03) students is not significant (*t* = 0.56, *p*=ns). It revealed that the Mean score of Metacognitive Awareness of Male and Female students do not differ significantly and therefore Male and Female students are similar in case of their Metacognitive Awareness.

In case of levels of Metacognitive Awareness, the critical ratio obtained for the comparison of Male and Female students in High Metacognitive Awareness Level (HMA) is found to be significant (*t* = 2.48, *p*<.05). It is evident from Table 25 that the Mean score of HMA for Male students (*M* = 87.88, *SD* = 5.01) is significantly higher than the HMA for Female students (*M* = 84.35, *SD* = 5.07). It shows that the Mean score of ***Metacognitive Awareness of Male and Female students in HMA differ significantly*** and the higher Mean value for Male students shows that the Male students are more metacognitively aware than Female Secondary School Students in HMA group.

Table 25 reveals that the critical ratio obtained for MMA (*t* = 0.75) and LMA (*t* = 0.09) between Male and Female students are not significant (*p*=ns). Hence, Male and the Female secondary students with MMA and LMA do not differ significantly and they have similar Level of Metacognitive Awareness.

Hence, the results of Gender wise difference in Metacognitive Awareness and its Levels (HMA, MMA, & LMA) of Secondary School Students revealed that ***there exist significant difference between Male and Female students of HMA Group and there is no significant difference*** was observed ***in the mean scores of MA, MMA and LMA*** of Secondary School Students on the basis of ***Gender.***

Comparison of the Mean Scores of Metacognitive Awareness and its Levels (HMA, MMA, & LMA) based on the subsample Locale of the Institution.

To find out the Locality wise differences of the Institution in case of the Predictor Variable namely, Metacognitive Awareness and its Levels such as; High Metacognitive Awareness (HMA), Moderate Metacognitive Awareness (MMA), and Low Metacognitive Awareness (LMA) the data were analysed with the help of t- test and the results are presented in Table 26.

Table 26

Data and Results of the Test of Significance of Difference between the Mean Scores of Metacognitive Awareness and its Levels (HMA, MMA, & LMA) for the Sub Sample Based on Locale of the Institution

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
MA	Urban	470	75.82	10.01	0.62^{ns}
	Rural	510	76.22	10.11	
HMA	Urban	92	88.40	5.95	0.59^{ns}
	Rural	112	87.98	4.17	
MMA	Urban	321	75.46	5.27	0.25^{ns}
	Rural	336	75.57	6.32	
LMA	Urban	57	57.54	4.84	1.02^{ns}
	Rural	62	58.48	5.16	

Note: ns. indicates not significant

Table 26 shows that the critical ratio obtained for Urban and Rural students in Metacognitive Awareness is not significant (t = 0.62, p=ns). It revealed that the Mean score of Metacognitive Awareness of Urban and Rural students do not differ significantly and may therefore the students from Urban and Rural area have similar Metacognitive Awareness.

In case of Levels of MA from Table 26, the critical ratio obtained for the comparison of the Mean scores of HMA (t = 0.59), MMA (t = 0.25) and LMA (t = 1.02) between Urban and Rural students is not significant (p=ns). It indicates that the Mean score of HMA, MMA and LMA of Urban and Rural students do not differ significantly and therefore students from Urban and Rural area are similar in case of their Metacognitive Awareness Level.

Hence, the results of Locality wise difference in Metacognitive Awareness and its Levels (HMA, MMA, & LMA) of Secondary School Students pointed that ***there is no significant difference*** was observed in the mean scores of ***Urban and Rural Secondary School Students in MA, HMA, MMA and LMA.*** Hence Secondary School Students are similar in Metacognitive Awareness and its Levels based on Locale of the Institution.

Comparison of the Mean Scores of Metacognitive Awareness and its Levels (HMA, MMA, & LMA) based on the subsample Type of Management of the Institution.

To find out the differences on the basis of Type of Management of the Institution selected for the study in case of the Predictor Variable namely, Metacognitive Awareness and its levels; High Metacognitive Awareness (HMA), Moderate Metacognitive Awareness (MMA), and Low Metacognitive Awareness (LMA) the data were analysed with the help of t- test and the results are given in Table 27.

Table 27

Data and Results of the Test of Significance of Difference between the Mean Scores of Metacognitive Awareness and its Levels (HMA), Moderate MMA, & LMA) for the Sub Sample Based on Type of Management of the Institution

Variables	Groups Compared	Mean	Standard Deviation	*t*- value
MA	Government	76.466	10.063	1.12^{ns}
	Aided	75.730	10.068	
HMA	Government	88.49	5.801	0.80^{ns}
	Aided	87.92	4.377	
MMA	Government	75.77	5.474	0.89^{ns}
	Aided	75.35	6.059	
LMA	Government	58.70	4.376	1.27^{ns}
	Aided	57.55	5.416	

Note: ns. indicates not significant

Table 27 shows that the critical ratio obtained for the comparison of the Mean scores of Metacognitive Awareness between Government and Aided students is not significant (t = 1.12, p=ns). It indicates that the Mean score of Metacognitive Awareness of Government and Aided students do not differ significantly and therefore students from Government and Aided sector have similar Metacognitive Awareness.

In case of Levels of MA, Table 27 shows that the critical ratio obtained for the comparison of the Mean scores of HMA (t = 0.80), MMA (t = 0.89) and LMA (t = 1.27) between Government and Aided students is not significant (p=ns). It indicates that the Mean score of High Metacognitive Awareness of Government and Aided students do not differ significantly and therefore students from Government and Aided sector are similar in case of their High Metacognitive Awareness.

In brief, the results of Management wise difference in Metacognitive Awareness and its Levels of Secondary School Students revealed that ***there exists no significant difference in MA, HMA, MMA and LMA of Secondary School Students.*** Hence Secondary School Students of Government and Aided sectors are equal in Metacognitive Awareness and its Levels.

Comparison of the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) based on the subsample Gender.

To find out the Gender wise differences in case of the three levels of Predictor Variable, Goal Orientation Viz; Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), and Performance-Avoidance Goal Orientation (PAVGO), the data were analysed with the help of t- test and the results are given in Table 28.

Table 28

Data and Results of the Test of Significance of Difference between the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) for the Sub Sample Based on Gender

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
MGO	Male	412	72.60	8.04	0.71^{ns}
	Female	568	71.21	8.69	
PAPGO	Male	412	71.60	8.07	2.38*
	Female	568	73.78	8.09	
PAVGO	Male	412	67.99	12.01	1.23^{ns}
	Female	568	67.08	10.63	

Note: *indicates $p<.05$; ns. indicates not significant

Table 28 reveals that the critical ratio obtained for the comparison of the Mean scores of Male and Female students in case of Performance-

Approach Goal Orientation is significant (t = 2.38, p<.05). It indicates that the Mean score of PAPGO of Male (M = 71.60, SD = 8.07) and Female (M = 73.78, SD = 8.09) students differ significantly and the greater mean scores associated with Female students indicates the superiority of Female students over their counterparts in Performance-Approach Goal Orientation.

From Table 28, it is clear that the critical ratio obtained for the comparison of the Mean scores of Male and Female students in case of Mastery Goal Orientation (t = 0.71) and Performance-Avoidance Goal Orientation (t = 1.23) are not significant (p=ns). It indicates that the mean score of MGO and PAVGO of Male and Female students do not differ significantly and therefore Male and Female students have similar Mastery and Performance-Avoidance Goal Orientation.

In brief, the results of Gender wise difference in the Mean scores of Goal Orientation (MGO, PAPGO, & PAVGO) of Secondary School Students revealed that ***there exists significant difference between Male and Female students in Performance-Approach Goal,*** and the Female students have greater tendency to adopt PAPGO than Male students. ***There exists no significant difference in MGO and PAVGO*** between ***Male and Female Secondary School Students***.

Comparison of the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) based on the subsample Locale of the Institution.

To find out the Locality wise differences in case of the three levels of Goal Orientation such as; Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), and Performance-Avoidance Goal

Orientation (PAVGO), the data were analysed with the help of t- test and the results are presented in Table 29.

Table 29

Data and Results of the Test of Significance of Difference between the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) for the Sub Sample Based on Locale of the Institution

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
MGO	Urban	470	70.92	8.80	1.61^{ns}
	Rural	510	71.79	8.04	
PAPGO	Urban	470	73.96	8.32	1.05^{ns}
	Rural	510	73.42	7.84	
PAVGO	Urban	470	67.50	11.73	0.10^{ns}
	Rural	510	67.43	10.76	

Note: ns. indicates not significant

From Table 29, the critical ratio obtained for the comparison of the Mean scores of Urban and Rural students in case of Mastery Goal Orientation (t = 1.61), Performance-Approach Goal Orientation (t = 1.05) and performance-Avoidance Goal Orientation (t = 0.10) is not significant (p=ns). It indicates that the Mean score of MGO, PAPGO and PAVGO of Urban and Rural students do not differ significantly and they have similar Goal Orientation.

In brief, the results of Locality wise difference in the Mean scores of Goal Orientation (MGO, PAPGO, & PAVGO) of Secondary School Students indicated that ***there exist no significant difference in the Mean scores of MGO, PAPGO and PAVGO between Urban and Rural*** Secondary School Students and they have similar tendency towards Goal Orientation.

Comparison of the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) based on the subsample Type of Management of the Institution.

To find out the Type of Management differences in case of the three levels of the Predictor Variable, Goal Orientation Viz; Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), and Performance-Avoidance Goal Orientation (PAVGO) the data were analysed with the help of t-test and the results are given in Table 30.

Table 30

Data and Results of the Test of Significance of Difference between the Mean Scores of Goal Orientation (MGO, PAPGO, & PAVGO) for the Sub Sample Based on Type of Management of the Institution

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
MGO	Government	401	70.96	10.84	1.29^{ns}
	Aided	579	71.69	6.21	
PAPGO	Government	401	73.92	8.30	0.78^{ns}
	Aided	579	73.51	7.92	
PAVGO	Government	401	67.61	11.63	0.34^{ns}
	Aided	579	67.36	10.96	

Note:ns. indicates not significant

From the Table 30, the critical ratio obtained for the comparison of the Mean scores of Government and Aided students in case of Mastery Goal Orientation (t = 1.29), Performance-Approach Goal Orientation (t = 0.78) performance-Avoidance Goal Orientation (t = 0.34) is not significant (p=ns). It indicates that the Mean score of MGO, PAPGO and PAVGO of Government and Aided students do not differ significantly and the students of these two groups are similar in their Mastery, Performance-Approach and performance-Avoidance Goal Orientation.

Hence, the results of the management wise difference in the Mean scores of Goal Orientation of Secondary School Students indicated that ***there exists no significant difference in MGO, PAPGO and PAVGO between Government and Aided Secondary School Students***. Hence the Secondary School Students of Government and Aided sectors are adopting similar goals in achievement situations.

Comparison of the Mean Scores of Learning Styles (VLS, ALS, & KLS) based on the subsample Gender.

To find out the Gender wise differences in case of the three levels of the Predictor Variable namely, Learning Styles Viz; Visual Learning Style (VLS), Auditory Learning Style (ALS), and Kinesthetic Learning Style (KLS) the data were analysed with the help of t-test and the results are given in Table 31.

Table 31

Data and Results of the Test of Significance of Difference between the Mean Scores of Learning Styles (VLS, ALS, & KLS) for the Sub Sample Based on Gender

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
VLS	Male	412	75.46	8.21	3.07**
	Female	568	77.15	8.73	
ALS	Male	412	68.81	6.88	1.98*
	Female	568	67.12	7.12	
KLS	Male	412	68.84	8.21	0.063^{ns}
	Female	568	68.80	8.55	

Note: **indicates *p*<.01;*indicates *p*<.05; ns. indicates not significant

Table 31 reveals that the critical ratio obtained for the comparison of the Mean scores of Male and Female students in case of Visual Learning Style is significant (t = 3.07, p<.01). It indicates that the Mean score of Visual Learning Style of Male (M = 75.46, SD = 8.21) and Female (M = 77.15, SD = 8.73) students differ significantly and the greater mean scores associated with Female students indicates the superiority of Female students over Male students in preferring Visual Learning Style.

Table 31 shows that the critical ratio obtained for the comparison of the Mean scores of Male and Female students in case of Auditory Learning Style is significant (t = 1.98, p<.05). It indicates that the Mean score of Auditory Learning Style of Male (M = 68.81, SD = 6.88) and Female (M = 67.98, SD = 7.77) students differ significantly and the greater Mean scores are associated with Male students indicates that Auditory Learning Style is more preferred by Male students than Female students.

From Table 31, the critical ratio obtained for the comparison of the Mean scores of Male and Female students in case of kinesthetic Learning Style is not significant (t = 0.063, p=ns). It indicates that the Mean score of kinesthetic Learning Style of Male and Female students do not differ significantly and therefore Male and Female students have similar preference towards Kinesthetic Style of learning.

Hence the results of the Gender wise difference in the Mean scores of Learning Styles (VLS, ALS, & KLS) of Secondary School Students implied that for ***Visual and Auditory Learning Styles, there exists significant difference between Male and Female students*** and the Female students have greater tendency to prefer VLS than Male students. ***There exists no significant difference in KLS*** between ***Male and Female*** Secondary School Students.

Comparison of the Mean Scores of Learning Styles (VLS, ALS, & KLS) based on the subsample Locale of the Institution.

To find out the Locality wise differences in case of the three levels of the Predictor Variable namely, Visual Learning Style (VLS), Auditory Learning Style (ALS), and Kinesthetic Learning Style (KLS). The data were analysed with the help of t-test and the results are given in Table 32.

Table 32

Data and Results of the Test of Significance of Difference between the Mean Scores of Learning Styles (VLS, ALS, & KLS) for the Sub Sample Based on Locale of the Institution

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
VLS	Urban	470	76.43	8.63	0.03^{ns}
	Rural	510	76.45	8.48	
ALS	Urban	470	68.40	7.72	0.28^{ns}
	Rural	510	68.26	7.13	
KLS	Urban	470	69.27	8.65	1.60^{ns}
	Rural	510	68.40	8.17	

Note: ns. indicates not significant

Table 32 shows that the critical ratio obtained for the comparison of the Mean scores of Urban and Rural students in case of Visual Learning Style (t = 0.03), Auditory Learning Style (t = 0.28) and Kinesthetic Learning Style (t = 1.60) are found not significant (p=ns). It indicates that the Mean score of VLS, ALS and KLS of Urban and Rural students do not differ significantly and may therefore Urban and Rural students are similar in their Learning Styles.

Hence, the results of the Locality wise difference in the Mean scores of Learning Styles (VLS, ALS, & KLS) of Secondary School Students implied that ***there exists no significant difference in VLS, ALS and KLS between Urban and Rural students*** and their tendency to prefer VLS, ALS and KLS is equal.

Comparison of the Mean Scores of Learning Styles (VLS, ALS, & KLS) based on the subsample Type of Management of the Institution.

To find out the Type of Management of Institution wise differences in case of the three levels of the Predictor Variable, Learning Styles Viz; Visual Learning Style (VLS), Auditory Learning Style (ALS), and Kinesthetic Learning Style (KLS). The data were analysed with the help of t- test and the results are presented in Table 33.

Table 33

Data and Results of the Test of Significance of Difference between the Mean Scores of Learning Styles (VLS, ALS, & KLS) for the Sub Sample Based on Type of Management of the Institution

Variables	Groups Compared	N	Mean	Standard Deviation	*t*- value
VLS	Government	401	75.79	8.43	1.98*
	Aided	579	76.89	8.61	
ALS	Government	401	68.40	7.14	0.25^{ns}
	Aided	579	68.27	7.60	
KLS	Government	401	69.07	9.02	0.78^{ns}
	Aided	579	68.64	7.96	

Note:*indicates p<.05; ns. indicates not significant

The Table 33 reveals that the critical ratio obtained for the comparison of the Mean scores of Government and Aided students in case of Visual Learning Style is significant (t = 1.98, p<.05). It indicates that the Mean score of Visual Learning Style of Government (M = 75.79, SD = 8.43) and Aided (M = 76.89, SD = 8.61) students differ significantly and the higher Mean score associated with Aided students indicates the superiority of students from Aided sector over Government students in preferring Visual Learning Style.

The critical ratio obtained for the comparison of the Mean scores of Government and Aided students in case of Auditory Learning Style (t = 0.25) and Kinesthetic Learning Style (t = 0.78) are not significant (p=ns). It indicates that the Mean score of ALS and KLS of Government and Aided students do not differ significantly and may therefore Government and Aided students are similar in case of Auditory and Kinesthetic Styles of Learning.

Hence, the results of Management wise difference in the Mean scores of Learning Styles of Secondary School Students indicated that ***there exists significant difference in Visual Learning Style between Government and Aided Secondary School Students***. Among them Aided students have greater tendency to prefer VLS than Government students. There exists no significant difference in ALS and KLS between Government and Aided students.

Comparison of the Mean Scores of Basic Process Skills in Chemistry Based on Gender, Locale and Type of Management of the Institution.

To find out the Gender, Locale and Type of Management differences in case of the select Criterion Variable namely, Basic Process Skills in

Chemistry the data were analysed with the help of t-test and the results are given in Table 34.

Table 34

Data and Results of the Test of Significance of Difference between the Mean Scores of Basic Process Skills in Chemistry for the Sub Samples Based on Gender, Locale and Type of Management of the Institution

Variable	Subsample	Groups Compared	Mean	Standard Deviation	*t*-value
Basic Process Skills in Chemistry	Gender	Male	76.54	15.53	2.01*
		Female	73.13	16.50	
	Locale	Urban	72.83	16.96	1.65^{ns}
		Rural	74.54	15.24	
	Type of Management	Govt	72.77	16.314	1.54^{ns}
		Aided	74.38	15.94	

Note:*indicates *p*<.05; ns. indicates not significant

Table 34 shows that the critical ratio obtained for the comparison of the Mean scores of Basic Process Skills in Chemistry between Male and Female students is significant (t = 2.01, p<.05). It indicates that the Mean score of Basic Process skills in Chemistry of Male (M = 76.54, SD = 15.53) and Female (M = 73.13, SD = 16.50) students differ significantly and therefore Male and Female students differ in their Basic Process Skills. Higher Mean score associated with Male students indicates that Male students are superior to Female students in Basic Process Skills in Chemistry.

Table 34 points that the critical ratio obtained for the comparison of the Mean scores of Basic Process Skills in Chemistry between Urban and Rural students (t = 1.66) and between Government and Aided students (t = 1.54) are not significant (p=ns). It implied that the Mean score of Basic Process Skills in Chemistry of students from Urban and Rural sectors and students from Government and Aided sectors do not differ significantly. Therefore these students are similar in case of their Basic Process Skills in Chemistry.

Hence, it can be concluded that ***there exists significant difference between Male and Female Secondary School Students in Basic Process Skills in Chemistry***; Male students are higher in BPS than their female counterpart. ***There exists no significant difference for the subsamples based on Locale and Type of Management of the Institution.***

Comparison of the Mean Scores of Criterion Variable; Integrated Process Skills in Chemistry Based on Gender, Locale and Type of Management of the Institution.

To find out the Gender, Locale and Type of Management differences in case of Integrated Process Skills in Chemistry; the data were analysed with the help of t- test and the results are presented in Table 35.

Table 35

Data and Results of the Test of Significance of Difference between the Mean Scores of Integrated Process Skills in Chemistry for the Sub Samples Based on Gender, Locale and Type of Management of the Institution

Variable	Subsample	Groups Compared	Mean	Standard Deviation	*t*-value
Integrated Process Skills in Chemistry	Gender	Male	67.36	16.86	0.21^{ns}
		Female	67.59	17.56	
	Locale	Urban	67.01	18.42	0.83^{ns}
		Rural	67.93	16.13	
	Type of Management	Govt	67.55	17.40	0.08^{ns}
		Aided	67.45	17.19	

Note: ns. indicates not significant

Table 35 reveals that the critical ratio obtained for the comparison of the Mean scores of Integrated Process Skills in Chemistry between Male and Female students (t = 0.21), between Urban and Rural students (t = 0.83) and between Government and Aided students (t = 0.08) are not significant (p=ns). It indicates that the Mean score of Integrated Process skills in Chemistry of Male and Female, Urban and Rural students and Government and Aided students do not differ significantly and therefore these students are similar in case of their Integrated Process Skills in Chemistry.

Hence, it can be concluded that ***there exists no significant difference in Integrated Process Skills in Chemistry of Secondary Scool Students based on Gender, Locale and Type of Management of the Institution***. Hence all students under these three groups are similar in their Integrated Process Skills.

Major Analysis-II

In this section of the chapter, the statistical technique; Stepwise Multiple Regression Analysis is used for identifying significant predictors and to determine their relative efficiency in predicting the Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry in terms of Total sample and sub samples based on Gender, Locale and Type of Management of Institution. The results obtained in this analysis are described in detail under the following sections.

Multiple Regression Analysis

Multiple Correlation and Regression Analysis using Step Wise Method (ANOVA Method) examines the regression of the Criterion Variable

(Y Score) on the multiple Predictor Variables (X Scores). A linear combination of Predictor Variables is achieved that maximizes the Multiple Correlation (*R*) between Predictor Variables and Criterion Variable. The description of the Regression analysis proceeds through three sections with interpretation regarding three groups of Coefficients. The first of these is composed of bivariate coefficients; for establishing the degree of bivariate relationships between the selected Predictor Variables and Criterion Variable as well as the relationships among the Predictor Variables themselves. The coefficient included for expressing the bivariate relationship is the bivariate *r* or Pearson's Coefficient of Correlation (*r*).

The second section is composed of coefficients that describe the overall regression equation. These are measures of "fit" of the regression equation to the model being tested. The two coefficients considered are; the Multiple Correlation (*R*) and its square, the Multiple Determination (R^2).

The third group is the largest and it is composed of coefficients that describe the role of the individual Predictor Variables in the Regression Analysis. These include the Unstanderdised (*B*) and Standardised (beta/β) Regression Coefficients.

The test of assumptions of normality, linearity and errors of prediction among the scores of Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry for the Total Sample and relevant subsamples are provided by the residual scatter plots presented in the Figures 8 and 9.

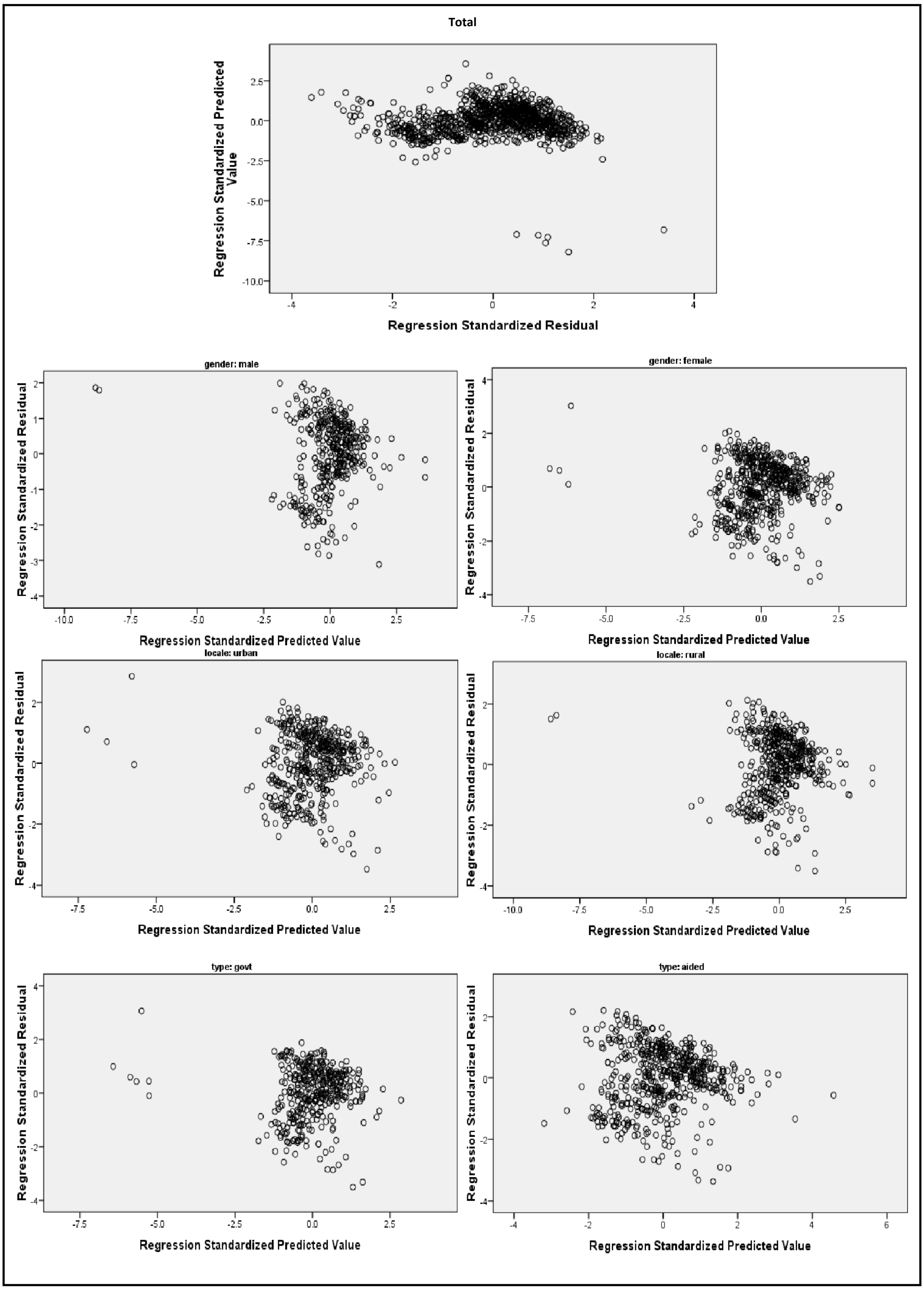


Figure 8. Scatter plot of Basic Process Skills in Chemistry for Total Sample and the relevant subsamples

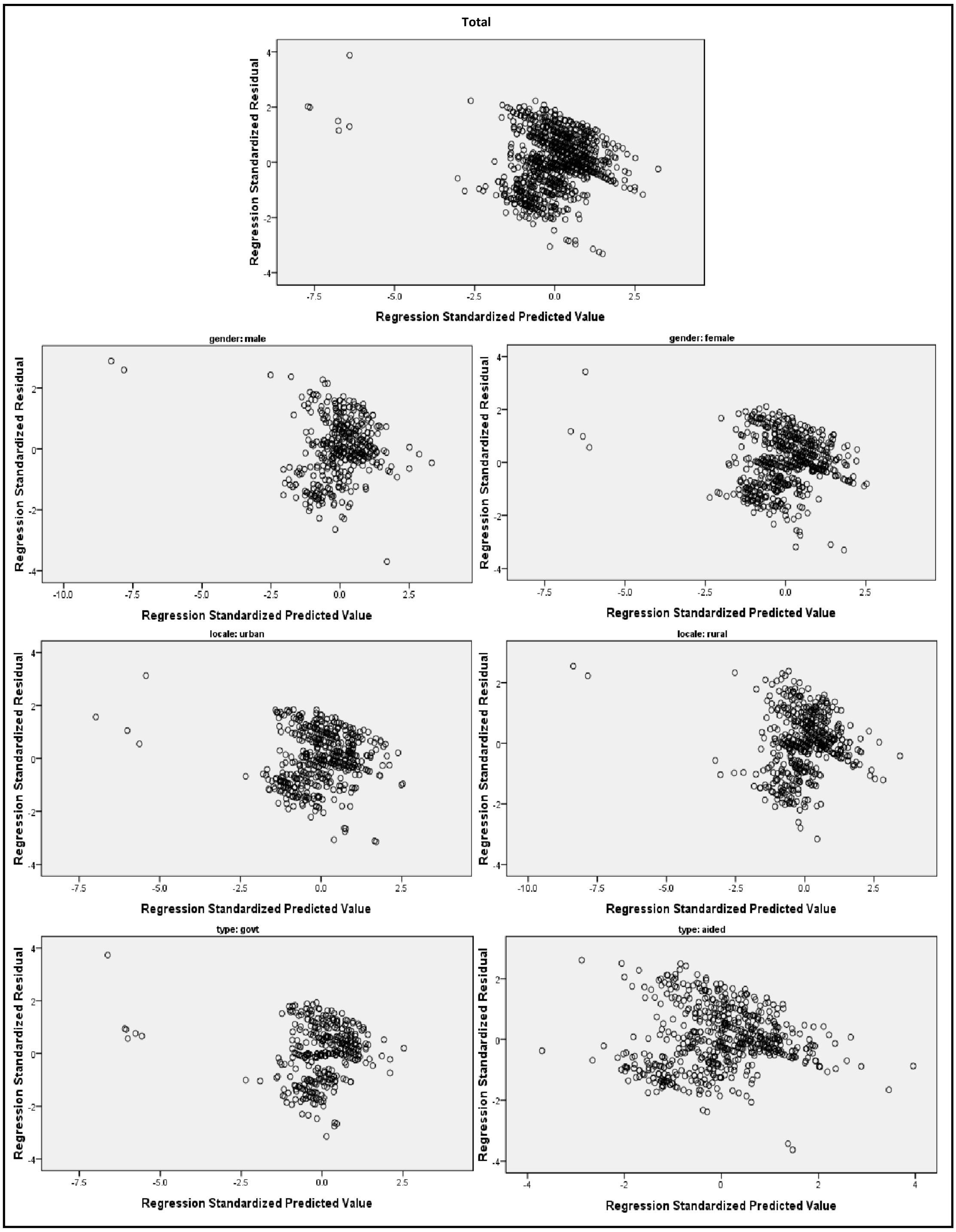


Figure 9. Scatter plot of Integrated Process Skills in Chemistry for Total Sample and the relevant subsamples

A visual examination of of residual scatter plots for the Total sample and the relevant subsamples revealed that a pile-up of scores in the center of the plot at each level of predicted scores of Basic and Integrated Process

Skills, with a normal distribution of residual errors around the center and the overall shape of the scatter plot was not curved, so linearity is also present in the sample. Thus, the residual graphs meet the assumptions of normality and linearity to a certain extent.

Multiple Regression Analysis of Basic Process Skills in Chemistry.

This section identifies the individual and joint contribution of Predictors; Metacognitive Awareness, Goal Orientation and Learning Styles in predicting the Basic Process Skills in Chemistry of Secondary School Students. The identification of the significant Predictors from the selected predictor Variables; Metacognitive Awareness, Goal Orientation (Mastery Goal Orientation, Performance-Approach Goal Orientation, and Performance-Avoidance Goal orientation), and Learning Styles (Visual Learning Style, Auditory learning Style, and Kinesthetic Learning Style) with the detailed interpretation regarding regression models derived for each sample is detailed in this section. The whole analysis was carried out for the Total sample and the subsamples based on Gender, Locale and Type of Management and this has been done using SPSS programme. The details of the analysis are presented as follows.

Relative Efficiency of Predictor Variables (MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS) in Predicting the Criterion Variable; Basic Process Skills in Chemistry for Total Sample.

In this part of the analysis, the investigator has employed the Multiple Regression Analysis with selected Predictor Variables;

Metacognitive Awareness (MA), Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), Performance-Avoidance Goal Orientation (PAVGO), Visual Learning Style (VLS), Auditory Learning Style (ALS) and Kinesthetic Learning Style (KLS) and Basic Process Skills in Chemistry (BPS) as the Criterion Variable. The data of the inter-correlation of Criterion Variable with Seven Predictor Variables are given in Table 36.

Table 36

Inter-correlation (Pearson's r) Matrix of the Criterion Variable; Basic Process Skills in Chemistry (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS) for the Total Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.077*	1.000						
MGO	.364**	-.057	1.000					
PAPGO	.153**	.111	.046	1.000				
PAVGO	$-.024^{ns}$	.006	-.065	-.023	1.000			
VLS	.068*	.173	-.079	.252	-.046	1.000		
ALS	-.080*	-.008	-.033	-.014	.036	.174	1.000	
KLS	$.043^{ns}$	.124	.028	.163	.010	.310	.315	1.000

Note: **indicates p<.01; *indicates p<.05; ns. indicates not significant

Table 36 reveals that the Pearson's Product Moment Coefficient of Correlation (r) between the Criterion Variable; BPS and the Predictor Variables; MA (r = .077, p<.05), MGO (r = .364, p<*.01*), PAPGO (r = .153, p<*.01*), PAVGO (r = -.024, p=ns), VLS (r = .068, p<.05), ALS (r = -.080, p<.05), and KLS (r = .043, p=ns) respectively. The computed *'r'* for the Predictor Variables; MA, MGO, PAPGO and VLS are verified as significant and found positively related with Basic Process Skills in Chemistry, whereas the indices of Correlation (r) reported for ALS implied significant and found negatively associated with BPS. But for the predictors PAVGO and KLS the value of '*r*' is not significant and found to have no association with BPS.

Hence the correlation matrix revealed that the Predictor Variables; MGO, PAPGO, MA, and VLS shows substantial or marked linear relation with Basic Process Skills in Chemistry; whereas the Predictor, ALS shows significant negative relation (non-linear) with BPS for the Total Sample.

a) ***Model Summary of the Significant Predictors; MGO, PAPGO, MA, and VLS with Basic Process Skills in Chemistry for the Total Sample.***

The model summary of the Regression Analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Determination (R^2 Change) with addition of predictors in successive stages for Total sample are given in the Table 37.

Table 37

Model Summary for Regression of the Significant Predictors; MGO, PAPGO, MA, and VLS *and the Criterion Variable; Basic Process Skills in Chemistry for the Total Sample*

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.364	.132	.131	.132	15.012
2	.388	.151	.149	.019	14.861
3	.397	.158	.155	.007	14.807
4	.407	.166	.162	.008	14.743

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
4. *Predictors:(Constant),MGO,PAPGO, MA, VLS*
   Criterion Variable: BPS

Table 37 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (*R*) for first, second, third and forth models are .364, .388, .397 and .407 respectively. The Coefficient of Determination (R^2) for first, second, third and forth models are .132, .151, .158 and .166 respectively. The detailed interpretation of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO, PAPGO, MA, and VLS to the Criterion Variable are explained in Table 38.

Table 38

ANOVA for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on the Criterion Variable; Basic Process Skills in Chemistry for the Total Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	33633.207	1	33633.207	149.227**
	Residual	220424.405	978	225.383	
	Total	254057.612	979		
2	Regression	38315.376	2	19157.688	86.757**
	Residual	215742.237	977	220.821	
	Total	254057.612	979		
3	Regression	40062.504	3	13354.168	60.906**
	Residual	213995.108	976	219.257	
	Total	254057.612	979		
4	Regression	42117.181	4	10529.295	48.438**
	Residual	211940.431	975	217.375	
	Total	254057.612	979		

Note: **indicates $p<.01$

Table 37 and Table 38 shows that four models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) on the Criterion Variable. Among the Predictor Variables, Mastery Goal Orientation (MGO) has the highest correlation (r = .364) with the criterion variable (BPS) and hence it was selected to enter first in the models of regression analysis. From the regression model summary, it is clear that, the Predictors; MGO, PAPGO, MA, and VLS which shows substantial or marked relation with Basic Process Skills in Chemistry are found to be emerging in the regression models but the predictor; ALS having significant negative relation with BPS is found to be excluded from the regression models along with PAVGO and KLS. It is eliminated because almost all of its shared variability with BPS overlaps with that of other predictors entered in the model being tested. The interpretation and discussion regarding emerged models are as follows.

With respect to Regression Model 1, it is clear that when the Predictor; Mastery Goal Orientation (MGO) alone was analysed as significant predictor and taken against the Criterion Variable (BPS), yielded a Coefficient of Multiple Correlation (R) of .364 with a Standard Error of the Estimate (SE_R) 15.012. The Coefficient of Determination (R^2) of Model 1 is .132 and the Adjusted R^2 is .131. The R^2 value implied that 13.2% of observed variance in the Basic Process Skill in Chemistry of Secondary School Students is accounted by the Mastery Goal Orientation because this model presents the contribution of MGO alone. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .132, $F(1, 978)$ = 149.22, $p<.01$) as the obtained value exceeds the tabled value of F ($F(1, 978)$ = 6.64).

In this model the values of R^2 and R^2 change are equal because this model explains the influence of a single predictor. It is therefore concluded that the Mastery Goal Orientation is emerged as the most potential predictor and contributes significantly to the model developed for Basic Process Skills in Chemistry of Secondary School Students.

Apart from the Regression Model 1, Regression Model 2 explains whether there exist any significant increases in the amount of variance accounted by the next Predictor Variable, Performance-Approach Goal Orientation (PAPGO) to BPS. In this model when the Predictor Variables; Mastery Goal Orientation (MGO) and Performance-Approach Goal Orientation (PAPGO) are jointly taken against the Criterion Variable (BPS), that yielded a Coefficient of Multiple Correlations (*R*) of .388 with a Standard Error of Estimate (SE_R) of 14.86. The Multiple Correlation Square (R^2) of Model 2 is .151 and the Adjusted R^2 is .149. The R^2 value implied that MGO and PAPGO together explain 15.1 % of the variance in the Basic Process Skill scores in Chemistry. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .151, $F(2, 977)$ = 86.75, $p<.01$) as the calculated *F*- value exceeds the tabled value of *F* ($F(2, 977) = 4.62$).

The value of *R* square change is .019 which revealed that the increase in percentage variance accounted for the variable; PAPGO to MGO is 1.9%. This suggests that, the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO is emerged as the second significant predictor in the sequence of predictors of the Basic Process Skills of Secondary School students in Chemistry for Total sample.

While considering the third model derived, it explains whether any significant increase in the amount of variance is accounted by the next Predictor Variable, Metacognitive Awareness (MA) to the Basic Process Skills in Chemistry. In this model, when the Predictor Variables; Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO) and Metacognitive Awareness (MA) are collectively taken against the Criterion Variable (BPS) and that yielded a Coefficient of Multiple Correlations (R) of .397 with a Standard Error of the Estimate of 14.80.

The coefficient of Determination (R^2) of Model 3 is 0.158 and the Adjusted R^2 is 0.155. The R^2 value implied that 15.8% of the observed variance in the Basic Process Skill scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 =.158, $F(3, 976) = 60.90$, $p<.01$) since the calculated F-value exceeds the tabled value of F ($F(3, 976) = 3.80$).

The value of R^2 change for Model 3 is .007 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is 0.7%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequential order of Predictors i.e. after MGO and PAPGO for predicting the Basic Process Skills in Chemistry of Secondary School students.

The last model (Model 4) derived from the Stepwise Regression Analysis deals the amount of variance accounted by the next predictor variable, Visual Learning Style (VLS) to the BPS. In this model, when the

Predictor Variables; Mastery Goal Orientation (MGO), Performance-Approach Goal Orientation (PAPGO), Metacognitive Awareness (MA) and Visual Learning Style (VLS) are collectively taken against the Criterion Variable (BPS), and that yielded a Coefficient of Multiple Correlation (*R*) of .407 with a Standard Error of the Estimate (SE_R) of 14.74. The Multiple Coefficient of Determination (R^2) of Model 4 is .166 and the Adjusted R^2 is .162. The R^2 value implied that 16.6% of the observed variance in the Basic Process Skill measure is accounted by the collective contribution of MGO, PAPGO, MA and VLS. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 =.162, $F(4, 975)= 48.43$, $p<.01$) at 0.01 level since the calculated *F*-value exceeds the tabled value of *F* ($F(3, 976) = 3.36$).

The value of R^2 change of this model is .008 which indicates that the increase in percentage variance accounted for the variable VLS to MGO, PAPGO and MA is 0.8%. This suggests that the predictor VLS is also significantly contributing to the derived model and it is the least predictor which comes last in the sequential order of predictors of Basic Process Skills in Chemistry of Secondary School Students.

b) Regression Coefficients of the Predictor Variables; MGO, PAPGO, MA, and VLS on Basic Process Skills in Chemistry for the Total Sample.

To understand the role of the individual Predictor Variables, the Standardized (Beta) and Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 39.

Table 39

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on the Criterion Variable; Basic Process Skills in Chemistry for the Total Sample

Model		Un standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	24.080	4.092		
	MGO	.695	.057	.364	12.216**
2	(Constant)	4.985	5.797		
	MGO	.683	.056	.358	12.114**
	PAPGO	.271	.059	.136	4.605**
3	(Constant)	-4.498	6.682		
	MGO	.693	.056	.363	12.311**
	PAPGO	.252	.059	.126	4.268**
	MA	.134	.047	.084	2.823**
4	(Constant)	5.191	7.362		
	MGO	.679	.056	.355	12.055**
	PAPGO	.297	.061	.149	4.904**
	MA	.155	.048	.097	3.254**
	VLS	.178	.058	.094	3.074**

Note: **indicates $p<.01$

Table 39 shows that for the derived Model 1, the Unstanderdised Regression Coefficient (B) of the Predictor, MGO is 0.695 with a Standard Error (SE_R) of 0.057. Hence it represents an amount 0.695 change in the BPS associated with a one unit change in MGO. Further the Standardized Regression Coefficient (beta/β) for MGO is 0.364. The critical ratio for the B and beta coefficients is statistically significant (t = 12.21, $p<.01$). It means that the individual contribution of MGO in predicting Basic Process Skills in Chemistry is significant and the percentage of contribution is 13.2%.

To develop a multiple regression equation for predicting the Criterion Variable; Basic Process Skills in Chemistry (BPS) from the Predictors; Metacognitive Awareness, Mastery Goal Orientation, Performance-Approach Goal Orientation, Performance-Avoidance Goal Orientation, Visual Learning Style, Auditory Learning Style, and Kinesthetic Learning Style, the following procedure has been used.

Let the Criterion Variable Basic Process Skills (BPS) = Y, and

Predictor Variable, X1 = Metacognitive Awareness (MA)

Predictor Variable, X2 = Mastery Goal Orientation (MGO)

Predictor Variable, X3 = Performance-Approach Goal Orientation (PAPGO)

Predictor Variable, X4= Performance-Avoidance Goal Orientation (PAVGO)

Predictor variable X5 = Visual Learning Style (VLS)

Predictor variable X6 = Auditory Learning Style (ALS)

Predictor variable X7 = Kinesthetic Learning Style (KLS)

The general regression equation of the Criterion Variable Y, in terms of the predictor Variables; X1, X2, X3, X4.............etc is given by Y= B© + B1X1 + B2X2 + B3X3 + B4X4 + B5X5 + B6X6 + B7X.....etc, where B© is the B value corresponding to the constant and B1, B2 and B3..... etc are B values corresponding to the Predictor Variables; X1, X2, X3, X4....etc. Hence the regression equation for the Model 1 in general form is given by Y = 24.08 + 0.695X2 and for the present study the equation can be written as BPS = 24.80 + 0.695MGO. This equation suggests that 0.695 unit increase in the Basic Process Skills in Chemistry can be significantly predicted for every unit increase in the Mastery Goal orientation (MGO). Hence the regression Prediction equation is fit to explain the model being tested.

Table 39 shows that for the Model 2, the Unstanderdised Regression Coefficients (*B*) of MGO is 0.683 and that of PAPGO is 0.271. The value of Standard Error of *B* for MGO is 0.056 and that of PAPGO is 0.059. Further the Standardized beta (β) weight of MGO is 0.358 and that of PAPGO is 0.136. The critical ratios for *B* and beta coefficients of MGO (t = 12.11) and PAPGO (t = 4.60) are statistically significant (p<*.01*). It means that the individual contributions of MGO and PAPGO in predicting Basic Process Skills in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 13.2% and 1.9% respectively.

The equation to the regression line for predicting Basic Process Skills in Chemistry (Y) by means of the Predictor Variables; MGO (X2) and PAPGO (X3) is Y = 4.985 + 0.683X2 + 0.271X3 in general form and in variable terms it can be written as BPS = 4.985 + 0.683MGO + 0.271PAPGO. This equation implied that this model explains an approximately 0.683 unit increase in the Basic Process Skills can be significantly predicted for every unit increase in the MGO measure when the effects of PAPGO is held constant and for every unit increase in the PAPGO (X3) could be associated with an increase of 0.271 units in Basic Process Skills Chemistry of Secondary School Students only when the effect of the variable MGO is nullified.

Table 39 shows that for the Model 3, the Unstanderdised Regression Coefficient (*B*) value of MGO, PAPGO and MA are 0.693, 0.252 and 0.134 respectively. The Standard Error of *B* weight for MGO is 0.056, PAPGO is 0.059 and that of MA is 0.047. The Standardised beta (β) weight of MGO is 0.363, PAPGO is 0.126 and that of MA is 0.084. The critical ratio for the *B* and beta weights of MGO (t = 12.83), PAPGO (t = 4.26), and MA (t = 2.83) are statistically significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the Basic Process Skills in Chemistry is significant and the corresponding percentages are 13.2%, 1.9% and 0.7% respectively. Hence the predictors; MGO, PAPAGO and MA are appeared as Positive significant predictors of Basic Process Skills in Chemistry.

The equation to the regression line for predicting Basic Process Skills in Chemistry (Y) by means of the Predictor Variables; MGO (X3), PAPGO (X4) and MA(X1) is Y = -4.498 + 0.693X2 + 0.252X3 + 0.084X1 in general form and in variable terms the equation can be written as BPS = - 4.498 + 0.693MGO + 0.252PAPGO + 0.084MA. This equation suggests that 0.693 unit increase in BPS can be significantly predicted for every unit increase in the score of MGO when the effects of PAPGO and MA are held constant and for unit increase in the PAPGO the Basic Process Skills is increased by 0.252 units, only when the effect of the variables MGO and MA are nullified. Similarly for unit increase in the MA, the Basic Process Skill is increased by 0.084 units when the effects of MGO and PAPGO are held constant.

Table 39 shows that the Unstanderdised Regression Coefficient (B) of the predictors as 0.679 for MGO, 0.297 for PAPGO, MA is 0.155 and that of VLS is 0.178. The value of Standard Error of B for MGO is 0.056, PAPGO is 0.061, MA is 0.048 and that of VLS is 0.058. Further the (β) presents the Standardised Regression Weights of this model are; MGO is 0.355, PAPGO is 0.149, MA is 0.097 and that of VLS is 0.094. The critical ratios for the B and beta coefficients of MGO (t =12.05), PAPGO (t = 4.90), MA (t = 3.25), and VLS (t = 3.07) are statistically highly significant (p<.01). It means that the individual contributions of PAPGO, MGO, MA and VLS in predicting the Basic Process Skills in Chemistry are significant and the percentage of individual contributions are 13.2%, 1.9%. 0.7% and 0.8% respectively. Therefore, PAPGO, MGO, MA and VLS are the positive significant predictors of Basic Process Skills in Chemistry of Secondary School Students.

The equation to the regression line for predicting Basic Process Skills In Chemistry (Y) by means of the Predictor Variables; MGO(X2), PAPGO(X3), MA(X1) and VLS(X5) is Y = 5.19 + 0.679X6 + 0.297X5 + 0.155X1 + 0.178X2 in general form and in the present case it can be represented as BPS = 5.19+ 0.697MGO + 0.297PAPGO + 0.155MA + 0.178VLS. This equation suggests that for an approximately 0.697 unit increase in BPS measure could be explained by every unit increase in MGO measure when the effects of PAPGO, MA and VLS are held constant and that for every unit increase in the PAPGO the Basic Process Skills is increases by 0.297 units, only when the effect of the variable MGO, MA and VLS are nullified. Similarly for 0.155 units increase in the Basic Process Skill can be predicted by every unit increase in the MA scores when the effects of MGO, PAPGO and VLS are nullified. But for 0.178 units increase in the Basic Process Skill can be significantly predicted for every unit increase in the measure of VLS when the effects of MGO, PAPGO and MA are held constant.

In brief, it can be said that, out of seven Predictor Variables, only four variables are emerged as the significant predictors and therefore four models are derived out of the Stepwise Regression Analysis. ***The Predictors; MGO, PAPGO, MA and VLS make significant influence (individually & collectively) upon BPS of Secondary School Students and the Predictors;***

PAVGO, ALS and KLS are not influencing the BPS in Chemistry of Secondary School Students. Among them MGO is the most significant positive predictor of Basic Process Skills in Chemistry for the Total sample.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS in Predicting the Criterion Variable; Basic Process Skills in Chemistry for the Male Sample.

In this section of the analysis, the investigator has employed the Multiple Regression Analysis with for Male Secondary School Students. The data of the inter-correlation of Criterion Variable with the seven Predictor Variables are given in Table 40.

Table 40

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for Male sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.018^{ns}	1.000						
MGO	.411**	-.121	1.000					
PAPGO	.162**	.105	.105	1.000				
PAVGO	-.034^{ns}	.012	-.077	-.044	1.000			
VLS	.030^{ns}	.128	-.076	.259	.016	1.000		
ALS	-.068*	.051	-.076	-.046	.054	.232	1.000	
KLS	.054^{ns}	.093	-.013	.134	.030	.297	.325	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not sigificant

Table 40 reveals that the Pearson's Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS. The computed 'r' values for the Predictor Variables; MGO (r = .411, p<.01), and PAPGO (r = .162, p<*.01*) are verified as significant and found positively related with Basic Process Skills in Chemistry. The '*r*' value of the predictor ALS (r = -.068, p<.05) reveals significant and found negatively correlated with BPS. The indices of Correlation (r) reported for the Predictors; MA (r = .018, p>.01), PAVGO (r = -.034, p>.01), VLS (r = .030, p>.01), and KLS (r = .054, p>.01) respectively indicates that there is no significant relation between MA, PAVGO, VLS, ALS and KLS with Basic Process Skills in Chemistry for Male Students.

Hence the correlation matrix inferred that the Predictor Variables; MGO and PAPGO shows substantial or marked linear relation with Basic Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non-linear) with BPS for the Male Sample.

a) Model Summary of the Significant Predictors; MGO and PAPGO on Basic Process Skills in Chemistry for the Male Sample.

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination with addition of predictors in successive stages (R^2 Change) for Male sample are given in the Table 41.

Table 41

Model Summary for the Regression of the Significant Predictors; MGO and PAPGO on Basic Process Skills in Chemistry for the Male Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.411	.169	.167	.169	14.171
2	.428	.183	.179	.014	14.072

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*

Criterion Variable: BPS

Table 41 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first and second models are .411 and .428 respectively. The Coefficient of Multiple Determination (R^2) for first and second models are .169 and .183 respectively. The detailed interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO and PAPGO to the Criterion Variable; BPS is explained in Table 42.

Table 42

ANOVA for Regression of the Predictor Variables; MG and PAPGO on Basic Process Skills in Chemistry for the Male Sample

	Model	Sum of Squares	*df*	Mean Square	*F*
1	Regression	16766.60	1	16766.60	83.42**
	Residual	82405.60	410	200.98	
	Total	99172.21	411		
2	Regression	18192.73	2	9096.36	45.94**
	Residual	80979.48	409	197.99	
	Total	99172.21	411		

Note: **indicates p<.01

From Table 41 and Table 42, two models are derived, which exhibit the relative contribution of predictors (individual and combined) on the Criterion Variable. MGO and PAPGO which shows substantial or marked relation with BPS are found to be emerged as the significant predictors in the regression models and all other Predictor Variables are excluded from the models. The Predictor; ALS having significant negative correlation is also excluded because almost all of its shared variability with BPS overlaps with that of other predictors entered in the model being tested. Among the Predictor Variables, MGO has the highest correlation (r = 0.411) with the BPS, it was selected to enter first in the model of regression analysis.The interpretation and discussion regarding emerged models are as follows.

With respect to the Regression Model 1, it is evident that the Predictor Variable; MGO alone was analysed as the significant predictor and which is taken against the BPS, which yielded a Coefficient of Multiple Correlation (R) of .411 with a Standard Error of the Estimate (SE_R) 14.17. The Coefficient of Determination (R^2) of Model 1 is .169 and the Adjusted R^2 is .161. The R^2 value implied that 16.9% of the observed variance in the BPS scores is accounted by the MGO because this model presents the sole contribution by MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .169, $F(1, 410)$ = 83.42, $p<.01$), as the obtained value exceeds the tabled value of F ($F(1, 410)$ = 6.66).

In this model the values of R^2 and R^2 change are equal because this model contains the influence of a single predictor i.e. MGO alone. It is therefore concluded that the Mastery Goal Orientation is identified as the most potential predictor and contributes significantly to the model developed for BPS for Male Secondary School Students.

Apart from the Model 1, the derived Model 2 explains whether there exist any significant increases in the shared common variance accounted by the next predictor variable, PAPGO along with MGO to the BPS. In this model the Predictor Variables; MGO and PAPGO are collectively taken against BPS, which yielded a Coefficient of Multiple Correlations (*R*) of .428 with a Standard Error of the Estimate (SE_R) of 14.07. The Multiple Coefficient of Determination (R^2) of the Model 2 is .183 and the Adjusted R^2 is .179. The R^2 value implied that 18.3% of the observed variance in the BPS scores in Chemistry is accounted by the collective contribution of MGO and PAPGO. The value of *F* obtained by the ANOVA method for the given *R* in the Model 2 is significant (R^2 =.183, $F(2, 409) = 45.94$, $p<.01$) since the calculated *F* -value exceeds the tabled value of *F* ($F(2, 409) = 4.62$).

The value of R^2 change is .014 indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 1.4%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the BPS of high school Male students in Chemistry Subject.

b) Coefficient Summary of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Male Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 43.

Table 43

Coefficient Summary for Regression of the *Predictor Variables;* MGO and PAPGO *on Basic Process Skills in Chemistry for the Male Sample*

Model		Unstanderdised Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	17.678	6.265		
	MGO	0.794	0.087	0.411	9.133**
2	(Constant)	2.321	8.451		
	MGO	0.770	0.087	0.399	8.870**
	PAPGO	0.232	0.086	0.121	2.684**

Note: **indicates p<.01

Table 43 reveals that for the derived Model 1, the Unstanderdised Regression Coefficient (B) of MGO is 0.794 with a Standard Error of B is 0.087. It indicates that an amount of 0.794 changes in the BPS is associated with a one unit change in MGO. Further the Standardised Regression weight (β) of MGO is 0.411. The critical ratio for B and beta coefficients of MGO is statistically highly significant (t = 9.13, p<.01). It means that the individual contribution of MGO in predicting BPS in Chemistry of Male students is significant and the percentage of contribution of MGO to BPS is 16.9%. Therefore MGO is the most significant positive predictor of BPS in Chemistry of Male Secondary School Students.

The equation to the regression line for predicting Basic Process Skills in Chemistry for Male sample by means of the predictor; MGO can be written as BPS = 17.678 + 0.794MGO. This equation suggests that an approximately 0.794 unit increase in the Basic Process Skills in Chemistry can be significantly predicted for every unit increase in the measure MGO for Male students. Hence the regression equation is fit to explain the model being tested.

Table 43 shows for the Model 2, the Unstanderdised Regression Coefficient (*B*) of MGO is 0.770 and that of PAPGO is 0.232. The value of Standard Error of *B* for MGO is 0.087 and that of PAPGO is 0.086. The Standardised Regression Weight (β) is 0. 399 for MGO and that of PAPGO is 0.121. The critical ratio for *B* and beta coefficients of MGO (t = 8.87) and PAPGO (t = 2.68) are statistically significant ($p<.01$). It means that the individual contributions of MGO and PAPGO in predicting BPS in Chemistry for Male students are highly significant and the percentage of individual contributions of MGO and PAPGO are 16.9% and 1.4% respectively. Hence the predictors; MGO and PAPGO are identified as the significant positive predictors of BPS in Chemistry for Male Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry by means of the predictor variables MGO and PAPGO can be written as BPS = 2.321 + 0.770MGO + 0.232PAPGO. This equation suggests that for every unit increase in MGO the increase in BPS is 0.770 units when the effects of PAPGO is held constant and also an approximately 0.232 unit increase in the BPS could be explained by every unit increase in the measure PAPGO when the effect of the MGO is nullified.

In brief, it can be said that out of seven Predictor Variables only two variables are emerged as the significant predictors and therefore two models are derived out of the Stepwise Regression Analysis. ***MGO and PAPGO are the significant predictors having significant influence (individually and collectively) on BPS of Male students;*** whereas the Predictors; MA, PAVGO, VLS, ALS and KLS are not influencing the BPS in Chemistry of Male Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS in Predicting the Criterion Variable; Basic Process Skills in Chemistry for Female Sample.

In this section of the analysis the investigator has employed the Multiple Regression analysis for Female Secondary School Students. The data of the inter-correlation of Criterion variable with the seven Predictor Variables are given in Table 44.

Table 44

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, and KLS) for the Female Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.119**	1.000						
MGO	.333**	-.014	1.000					
PAPGO	.145**	.116	.007	1.000				
PAVGO	-.020^{ns}	.002	-.058	-.007	1.000			
VLS	.086*	.203	-.079	.251	-.088	1.000		
ALS	-.091*	-.044	-.009	.006	.020	.150	1.000	
KLS	.036^{ns}	.146	.055	.183	-.006	.321	.309	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 44 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables. The computed 'r' for the predictors; MA (r = .119, p<*.01*), MGO (r = .333, p<*.01*), PAPGO (r = .145, p<*.01*) and VLS (r = .086, p<.05) verified that there exist significant and found positive relation between these variables and Basic Process Skills in

Chemistry. The index of correlation reported for ALS (r = -.091, p<.05) indicates significant and found negative relation with BPS. The predictors PAVGO (r =.020, p=ns) and KLS (r =.036, p=ns) shows that there is no significant assosiation between PAVGO and KLS with BPS.

Hence the correlation matrix inferred that the Predictor Variables; MGO, PAPGO, MA, and VLS shows substantial or marked linear relation and the Predictor, ALS shows significant negative (non-linear) relation with BPS in Chemistry for Female students.

a) ***Model Summary of MGO, PAPGO, MA, and VLS with Basic Process Skills in Chemistry for Female Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors for Female sample are given in the Table 45.

Table 45

Model Summary for Regression of the Significant Predictor Variables; MGO, PAPGO, MA, and VLS on Basic Process Skills in Chemistry for Female Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.333	.111	.109	.111	15.571
2	.363	.131	.128	.020	15.402
3	.378	.143	.138	.012	15.317
4	.397	.158	.152	.015	15.191

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
4. *Predictors:(Constant),MGO,PAPGO, MA, VLS*

Criterion Variable: BPS

Table 45 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first, second, third and forth models are .333, .363, .378 and .397 respectively. The Multiple Coefficient of Determination (R^2) for first, second, third and forth models are .111, .131, .143 and .158 respectively. The details of the interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO, PAPGO, MA, and VLS to the Criterion Variablea are shown in Table 46.

Table 46

ANOVA for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on Basic Process Skills in Chemistry for Female Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	17132.563	1	17132.563	70.639**
	Residual	137275.797	566	242.537	
	Total	154408.359	567		
2	Regression	20291.810	2	10145.905	42.742**
	Residual	134116.549	565	237.374	
	Total	154408.359	567		
3	Regression	22073.563	3	7357.854	31.359**
	Residual	132334.796	564	234.636	
	Total	154408.359	567		
4	Regression	24336.846	4	6084.211	26.335**
	Residual	130071.514	563	231.033	
	Total	154408.359	567		

Note: **indicates p<.01

From Table 45 and Table 46, four models derived, which exhibit the relative contribution of Predictor Variables (individual and combined) on the Criterion Variable. The Predictor Variables; MGO, MA, PAPGO and VLS shows substantial or marked positive relation with BPS in Chemistry are found to be emerged in the derived regression models, but the Predictor ALS having significant association with BPS is found to be excluded from the regression models because almost all of its shared variability with BPS overlaps with that of other predictors entered in the model being tested. Among the Predictor Variables, MGO has the highest correlation (r = .333) with BPS and hence it was selected to enter first in the analysis.The interpretation and discussion regarding emerged models are as follows.

With respect to Regression Model 1, it is clear that the Predictor Variable; MGO was analysed as the most significant Predictor and it is taken against BPS, that yielded a Coefficient of Multiple Correlations (R) of .333 with Standard Error of the Estimate (SE_R) is 15.57. The Multiple Coefficient of Determination (R^2) of Model 1 is .111 and the Adjusted R Square is .109. The R^2 value implied that 11.1% of the observed variance in the BPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 =.111, $F(1, 566)$ = 70.63, p<.01) as the obtained value exceed the tabled value of F ($F(1, 566)$ = 6. 66).

In this model, the values of R^2 and R^2 change are equal because this model contains the influence of a single predictor i.e. MGO alone. It is therefore concluded that the MGO is identified as the most potential predictor and contributes significantly to the model developed for BPS in Chemistry for Female Secondary School Students.

Apart from the Model 1, the derived Model 2 shows whether there exist any significant increases in the amount of variance accounted by the next predictor variable, PAPGO to the BPS. In this model, the Predictor Variables; MGO and PAPGO are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (R) of .363 with a Standard Error of the Estimate (SE_R) is 15.40. The Multiple Coefficient of Determination (R^2) of Model 2 is .131 and the Adjusted R^2 is .128. The R^2 value implied that 13.1 % of the observed variance in the BPS scores in Chemistry is accounted by the collective contribution of MGO and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 =.131, $F(2, 565) = 42.72$, $p<.01$) since the calculated F- value exceeds the tabled value of F ($F(2, 565) = 4.62$).

The value of R^2 change is .020 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 2.0%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the BPS of Female Secondary School Students in Chemistry Subject.

While considering the third model (Model 3) derived from the regression analysis, it explains the significant increase in the amount of variance accounted by the next Predictor Variable, MA to BPS. In this model, when MGO, PAPGO and MA are collectively taken against the Criterion Variable (BPS), which yielded a Coefficient of Multiple Correlations (R) of .378 with a Standard Error of the Estimate (SE_R) is 15.31. The Multiple Coefficient of Determination (R^2) of Model 3 is .143 and the Adjusted R^2 is .138. The R^2 value implied that 14.3% of the observed variance in the BPS scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant ($R^2 = .143$, $F(3, 564) = 31.35$, $p < .01$) since the calculated F- value exceeds the tabled value of F ($F(3, 564) = 3.80$).

The value of R^2 change is .012 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is 1.2%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and PAPGO for predicting the BPS of Female Secondary School Students.

With respect of the Model 4, the last model derived from the Stepwise Regression Analysis reveals the significant increase in the amount of variance accounted by the next Predictor Variable, VLS to the BPS. In this model the Predictor Variables; MGO, PAPGO, MA, and VLS are collectively taken against BPS, which yielded a Coefficient of Multiple Correlations (R) of .397 with a Standard Error of the Estimate (SE_R) is 15.19. The Multiple Coefficient of Determination (R^2) of Model 4 is .158 and the Adjusted R^2 is .152. The R^2 value implied that 15.8% of the observed variance in the Basic Process Skill scores is accounted by the collective contribution of MGO, PAPGO, MA, and VLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant ($R^2 = .158$, $F(4, 563) = 26.33$, $p < .01$) since the calculated F-value exceeds the tabled value of F ($F(4, 563) = 3.34$).

The value of R^2 change is .015 which indicates that the increase in percentage variance accounted for the variable VLS to MGO, PAPGO and MA is 1.5%. This suggests that the predictor; VLS is also significantly contributing to the derived model and it is the least predictor which comes last in the sequential order for predicting the Basic Process Skills of Female Secondary School Students.

b) Coefficient Summary of the Predictor Variables; MGO, PAPGO, MA, and VLS on Basic Process Skills in Chemistry for the Female Sample.

To understand the role of the individual Predictor Variables, the Standardised (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 47.

Table 47

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on Basic Process Skills in Chemistry for the Female Sample

Model		Unstandardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	28.130	5.394		
	MGO	.632	.075	.333	8.40**
2	(Constant)	6.796	7.917		
	MGO	.630	.074	.332	8.47**
	PAPGO	.292	.080	.143	3.64**
3	(Constant)	5.078	8.973		
	MGO	.633	.074	.334	8.55**
	PAPGO	.266	.080	.130	3.32**
	MA	.178	.065	.108	2.75**
4	(Constant)	7.646	9.788		
	MGO	.614	.074	.324	8.34**
	PAPGO	.326	.082	.160	3.99**
	MA	.214	.065	.130	3.29**
	VLS	.241	.077	.128	3.130**

Note: **indicates $p<.01$

Table 47 shows that for the derived Model 1, the Unstanderdised Regression Coefficients (*B*) value of MGO is 0.632 and the Standard Error of *B* is 0.075. Further the β value presents the Standardised Regression Weight of MGO is 0.333. The critical ratio for the *B* and beta value of MGO is statistically highly significant (t = 8.40, p<*.01*). It means that the individual contribution of MGO in predicting BPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 11.1%. Therefore MGO is the most significant positive predictor of BPS in Chemistry of Female Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the Predictor Variable; MGO can be written as BPS = 28.13 + 0.632MGO. This equation suggests that 0.632 unit increase in the BPS in Chemistry can be significantly predicted for every unit increase in the measure MGO for this model.Hence the regression equation is fit to explain this model being tested.

Table 47 points that for the Model 2, the Unstanderdised Regression Coefficients (*B*) of MGO is 0.630 and that of PAPGO is 0.292. The value of Standard Error of *B* for MGO 0.074 and that of PAPGO is 0.080. Further β value presents Standardized Regression Weights, for MGO it is 0.332 and that of PAPGO is 0.143 for this model. The critical ratios for the *B* and beta weights of MGO (t = 8.47) and PAPGO (t = 3.64) revealed that they are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting BPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 11.1% and 2.0% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of BPS in Chemistry for Female students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the predictor variables MGO and PAPGO can be written as BPS = 6.79 + 0.630MGO + 0.292PAPGO. This equation suggests that for unit increase in MGO, the increase in BPS is 0.630 units when the effects of PAPGO is held constant and that for unit increase in the PAPGO the Basic Process Skills is increased by 0.292 units, only when the effect of the variable MGO is nullified.

Table 47 reveals that for the Model 3, the Unstanderdised Regression Coefficient '*B*' weight of the predictors in writing the regression equation is 0.633 for MGO, 0.266 for PAPGO and that of MA is 0.178. The value of Standard Error of B for MGO is 0.074, PAPGO is 0.080 and that of MA is 0.065. Further, the β value presents Standardized Regression weight of MGO is 0.334, PAPGO is 0.130 and that of MA is 0.108. The critical ratios for the B and beta values of MGO (t = 8.55), PAPGO (t = 3.32) and MA (t = 2.75) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the BPS in Chemistry is also significant and the corresponding percentages are 11.1%, 2.0% and 1.2% respectively. Therefore MGO, PAPAGO and MA are Positive significant predictors of BPS in Chemistry of Female Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the Predictor Variables; MGO, PAPGO and MA can be written as BPS = 5.07 + 0.633MGO + 0.266PAPGO + 0.178MA. This equation suggests that 0.633 unit increase in BPS can be significantly predicted for every unit increase in the score of MGO when the effects of PAPGO and MA is held constant and for every unit increase in the PAPGO is associated with Basic Process Skills increase by 0.266 units, only when the effect of the variables MGO and MA is nullified. Similarly every unit increase in MA the Basic Process Skill is accompanied by an increase of 0.178 units when the effects of MGO and PAPGO are held constant.

Table 47 gives the Unstanderdised Regression Coefficient (*B*) of Predictor Variables in writing the regression equation is 0.614 for MGO, 0.326 for PAPGO, MA is 0.214 and that of VLS is 0.241. The value of Standard Error of B for MGO is 0.074, PAPGO is 0.082, MA is 0.065 and that of VLS is 0.077. Further β value presents the Standardized Regression weight of MGO is 0.324, PAPGO is 0.160, MA is 0.130 and that of VLS is 0.128. The'*t*' values for the *B* and beta values of MGO (t = 8.34), PAPGO (t = 3.99), MA (t = 3.29) and VLS (t = 3.13) are statistically highly significant (p<.01). It means that the individual contributions of PAGO, MGO, MA and VLS in predicting the Basic Process Skills in Chemistry is significant and the percentage of individual contributions are 11.1%, 2%. 1.2% and 1.5% respectively. Therefore PAGO, MAG, MA and VLS are the significant predictors of BPS in Chemistry of Female Secondary School Students.

The equation to the regression line for predicting Basic Process Skills in Chemistry (Y) by means of the Predictor Variables MGO(X2), PAPGO (X3), MA(X1) and VLS (X5) can be represented as BPS = 7.64 + 0.614MGO +

0.326PAPGO + 0.214MA + 0.241VLS. This equation suggests that every unit increase in MGO is accompanied by an increase of 0.614 units in BPS when the effects of PAPGO, MA and VLS are held constant and for every unit increase in the PAPGO the BPS is increased by 0.326 units, only when the effect of the variable MGO, MA and VLS are nullified. Also, 0.241 unit increase in the BPS of Female students can be significantly predicted by every unit increase in the predictor VLS, when the effects of MGO, PAPGO and MA are held constant.

In brief, it can be summarised that, out of seven Predictor Variables only four variables are emerged as the significant predictors and therefore four models are derived out of the Stepwise Regression Analysis. ***MGO, PAPGO, MA and VLS are the predictors having significant influence (individually and collectively) on BPS of Female students;*** whereas the Predictors; PAVGO, ALS and KLS are not influencing the BPS in Chemistry of Female Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS in Predicting the Criterion Variable; Basic Process Skills in Chemistry for Urban Sample.

In this section of the analysis, the investigator has employed the Multiple Regression Analysis for Urban Sample. The data of the inter-correlation of Criterion variable with Seven Predictor Variables are given in Table 48.

Table 48

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS) for the Urban Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.088*	1.000						
MGO	.336**	-.036	1.000					
PAPGO	.101**	.055	.004	1.000				
PAVGO	$.030^{ns}$	-.033	-.053	-.014	1.000			
VLS	.160**	.158	-.160	.235	-.085	1.000		
ALS	-.094*	.008	-.008	-.019	.013	.173	1.000	
KLS	$.046^{ns}$	.162	.010	.127	.038	.299	.306	1.000

Note: **indicates *p*<.01; *indicates *p*<.05; ns. indicates not significant

Table 48 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables. The computed '*r*' for the variables MA (r = .088, p<.05), MGO (r = .336, p<.01), PAPGO (r = .101, p<.01) and VLS (r = .160, p<.01) shows that there exist significant positive relation of these variables with Basic Process Skills in Chemistry for Urban students. The indices of correlation reported for ALS is (r = -.094, p<.05) indicates significant negative relation with BPS. The Predictors; PAVGO (r =.030, p=ns) and KLS (r = .046, p=ns) shows no significant relation with BPS.

Hence the correlation matrix revealed that the Predictor Variables; MGO, PAPGO, MA, and VLS shows substantial or marked linear relation with Basic Process Skills in Chemistry; whereas the Predictor; ALS shows significant negative relation (non-linear) with BPS for Urban Sample.

a) ***Model Summary of the Predictor Variables; MGO, VLS, PAPGO, and MA on Basic Process Skills in Chemistry for the Urban Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and Changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages for Urban sample is given in the Table 49.

Table 49

Model Summary for Regression of the Predictor Variables; MGO, VLS, PAPGO, and MA on Basic Process Skills in Chemistry for the Urban Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.336	.113	.111	.113	15.991
2	.352	.124	.121	.012	15.902
3	.376	.141	.136	.017	15.771
4	.393	.155	.147	.013	15.662

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, VLS*
3. *Predictors: (Constant), MGO, VLS, PAPGO*
4. *Predictors:(Constant),MGO,VLS, PAPGO, MA*

Criterion Variable: BPS

Table 49 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first, second, third and forth models are .336, .352, .376 and .393 respectively. The Coefficient of Determination (R^2) for first, second, third and forth models are .113, .124, .141 and .155 respectively. The detailed interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO, VLS, PAPGO, and MA to the Criterion Variable are presented in Table 50.

Table 50

ANOVA Summary for Regression of the Predictor Variables; MGO, VLS, PAPGO, and MA on Basic Process Skills in Chemistry for the Urban Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	15195.636	1	15195.636	59.370**
	Residual	119784.075	468	255.949	
	Total	134979.711	469		
2	Regression	16771.344	2	8385.672	33.129**
	Residual	118208.367	467	253.123	
	Total	134979.711	469		
3	Regression	19045.394	3	6348.465	25.518**
	Residual	115934.317	466	248.786	
	Total	134979.711	469		
4	Regression	20860.562	4	5215.141	21.250**
	Residual	114119.149	465	245.418	
	Total	15195.636	469	15195.636	

Note: **indicates $p<.01$

Table 49 and Table 50, shows that four models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) on the Criterion Variable. Among the Predictor Variables, MGO has the highest correlation (r = .336) with the BPS and hence it was selected to enter first in the models of regression analysis. The Predictor Variables; MGO, MA, PAPGO, VLS and ALS shows substantial or marked relation with Basic Process Skills in Chemistry and is found to be entered except ALS, which is found to be excluded from the regression models. ALS is eliminated because almost all of its shared variability with BPS overlaps with that of other predictors entered in the model being tested.The predictors; PAVGO and KLS, with no significant association with BPS are not entered as the Predictor Variables in the regression models. The interpretation and discussion regarding emerged models are as follows.

With respect to Regression Model 1, it is evident that MGO alone was analysed as the predictor and it is taken against the Criterion Variable (Y), that yielded a Coefficient of Multiple Correlation (R) of .336 and the Standard Error of the Estimate (SE_R) is 15.99. The Coefficient of Determination (R^2) of Model 1 is .113 and the Adjusted R^2 is 0.111. The R^2 value implied that 11.3% of the observed variance in the BPS scores in Chemistry is accounted by the MGO because this model presents the sole contribution of MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 =.113, F(1, 468) =59.37, p<.01) as the obtained value exceed the tabled value of F (F(1, 468) = 6.66).

In this model the values of R^2 and R^2 change are equal because this model contains the influence MGO and it is identified as the most potential predictor which contributes significantly to the model developed for Basic Process Skills in Chemistry for Urban Secondary School Students.

While considering the Model 2, it explains whether there exist any significant increases in the amount of variance accounted by the next Predictor Variable, VLS to the BPS. In this model, when MGO and VLS are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (R) of .352 with a Standard Error of the Estimate (SE_R) of 15.90. The Multiple Correlation Square (R^2) of Model 2 is .124 and the Adjusted R^2 is 0.121. The R^2 value translated and explained that 12.4% of the observed variance in the BPS scores is accounted by the collective contribution of MGO and VLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 =.124, $F(2, 467) = 33.12$, $p<.01$) since the calculated F-value exceeds the tabled value of F (F (2, 467) = 4.62).

The value of R^2 change is .012 which indicates that the increase in percentage variance accounted for the variable VLS to MGO is 1.2%. This suggests that the predictor VLS is also significantly contributing to the Model 2 along with MGO. In this model the VLS emerged as the second predictor next to MGO in the sequence of predicting the BPS of Urban High School Students in Chemistry Subject.

The next model derived from the regression explains the significant increase in the amount of variance accounted by the next predictor variable, PAPGO to the BPS. In this model, when MGO, VLS, and PAPGO are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (R) of .376 with a Standard Error of the Estimate (SE_R) of 15.77. The Coefficient of Determination (R^2) of Model 3 is .141 and the Adjusted R^2 is .136. The R^2 value implied that 14.1% of the observed variance in the BPS scores is accounted by the collective contribution of MGO, VLS and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 = .136, $F(3, 466) = 25.51$, $p<.01$) since the calculated F- value exceeds the tabled value of F ($F(3, 466) = 3.80$).

The value of R^2 change is .017 which indicates that the increase in percentage variance accounted for the variable PAPGO, MGO and VLS is 1.7%. This model suggests that the predictor PAPGO is also significantly contributing to this model and it comes third in the sequential order i.e. after MGO and VLS for predicting the BPS in Chemistry of Secondary School Students belongs to the Urban Sector.

Apart from the Model 4, the last model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, MA to the BPS. In this model, MGO, VLS, PAPGO, and MA are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (R) of .393 with Standard Error of the Estimate (SE_R) of 15.66. The Multiple Correlation Square (R^2) of Model 4 is .155 and the Adjusted R^2 is 0.147. The R^2 value implied that 15.5% of the observed variance in the BPS scores is accounted by the collective contribution of MGO, VLS, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 =.155, $F(4, 465) = 21.25$, $p<.01$) since the calculated F- value exceeds the tabled value of F ($F(4, 465) = 3.32$).

The value of R^2 change is .013 which indicates that the increase in percentage variance accounted for the variable MA, MGO, VLS and PAPGO is 1.3%. This suggests that the predictor VLS is also significantly contributing to the derived model and it is the least predictor which comes last in the sequential order for predicting the BPS of Urban High School Students.

b) *Coefficient Summary of the Predictor Variables MGO, VLS, PAPGO, and MA on Basic Process Skills in Chemistry for the Urban Sample.*

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 51.

Table 51

Coefficient Summary for Regression of the *Predictor Variables MGO, VLS, PAPGO, and MA on Basic Process Skills in Chemistry for the Urban Sample*

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	27.003	5.994		
	MGO	.646	.084	.336	7.705**
2	(Constant)	45.831	9.616		
	MGO	.612	.084	.318	7.249**
	VLS	.215	.086	.109	2.495*
3	(Constant)	31.319	10.674		
	MGO	.602	.084	.312	7.175**
	VLS	.279	.088	.142	3.166**
	PAPGO	.272	.090	.134	3.023**
4	(Constant)	19.073	11.518		
	MGO	.604	.083	.314	7.254**
	VLS	.314	.088	.160	3.551**
	PAPGO	.268	.089	.131	2.993**
	MA	.199	.073	.117	2.720**

Note: **indicates *p*<.01

Table 51 revealed that for the derived Model 1, the Unstanderdised Regression Coefficient (*B*) of MGO is 0.646 with a Standard Error of 0.084. Hence it represents an amount 0.646 change in the BPS is associated with a one unit change in MGO. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.336. The critical ratio for the *B* and the beta coefficients of MGO is statistically highly significant (t = 7.70, p<.01). It means that the individual contribution of MGO in predicting BPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 11.3%. Therefore MGO is the most significant positive predictor of Basic Process Skills in Chemistry for Urban Secondary School Students.

The equation to the regression line for predicting Basic Process Skills in Chemistry for Urban sample (Y) by means MGO for the Model 1 can be written as BPS = 27.00 + 0.646MGO. This equation suggests that for every unit increase in the Predictor MGO accompanied by 0.642 unit increase of in the Basic Process Skills in Chemistry.

Table 51 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight of this variable in writing the regression equation 0. 612 for MGO and that of VLS are 0.215. The value of Standard Error of *B* for MGO is 0.086 and that of VLS is 0.084. Further 'β' value presents Standardized Regression weight for MGO is 0.318 and that of VLS is 0.109. The critical ratios for the *B* and the beta coefficients of MGO (t = 7.24) and VLS (t = 2.49) are statistically significant (p<.01, p<.05). It means that the individual contributions of MGO and VLS in predicting BPS in Chemistry are highly significant and the percentage of individual contributions of

MGO and VLS are 11.1% and 1.2% respectively. Hence the predictors MGO and VLS are identified as the significant predictors of BPS in Chemistry of Urban Sample.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the Predictor Variables MGO and VLS can be written as BPS = 45.83 + 0.612MGO + 0.215VLS. This equation suggests that 0.612 unit increase in BPS can be significantly predicted for every unit increase in MGO when the effects of VLS is held constant and that for every unit increase in the VLS; the Basic Process Skills in Chemistry is increased by 0.215 units only when the effect of the variable MGO is nullified.

Table 51 shows that for Model 3, the Unstanderdised Regression (*B*) weights of the predictors are; 0.602 for MGO, 0.279 for VLS and that of PAPGO is 0.272. The value of Standard Error of *B* for MGO is 0.084, VLS is 0.088 and that of PAPGO is 0.090. Further 'β' value presents Standardized Regression weight of MGO is 0.312, VLS is 0.142 and that of PAPGO is 0.134 for this model. The critical ratios for the beta values for MGO (t = 7.17), VLS (t = 3.16) and PAPGO (t = 3.02) are statistically highly significant (p<.01). It means that the individual contributions of MGO, VLS and PAPGO in predicting the BPS in Chemistry is significant and the corresponding percentages are 11.3%, 1.2% and 1.7% respectively. Therefore MGO, VLS and PAPGO are significant predictors of BPS in Chemistry for Urban Sample.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the Predictor Variables; MGO, VLS and PAPGO can be written as BPS = 19.07 + 0.602MGO + 0.279VLS + 0.272PAPGO. This equation suggests that for every unit increase in MGO, the increase in BPS is 0.602 units when the effects of VLS and PAPGO is held constant and that for every unit increase in the VLS the Basic Process Skills is increased by 0.279 units, only when the effect of the variables MGO and PAPGO is nullified. Similarly for 0.272 unit increase in the Basic Process Skill can be predicted for every unit increase in the measure PAPGO when the effects of MGO and VLS are held constant.

For Model 4, the Unstanderdised Regression Coefficients (*B*) for writing the regression equation is 0.604 for MGO, 0.314 for VLS, PAPGO is 0.268 and that of MA is 0.199. The value of Standard Error of *B* for MGO is 0.083, VLS is 0.088, PAPGO is 0.089 and that of MA is 0.073. Further β value presents Standardized Regression weight for MGO is 0.314, VLS is 0.160, PAPGO is 0.131 and that of MA is 0.117.The critical ratio for the beta values of MGO (t = 7.25), VLS (t = 3.55), PAPGO (t = 2.99) and MA (t = 2.72) are statistically highly significant (p<.01). It means that the combined contributions of MGO, VLS, PAGO, and MA in predicting Basic Process Skills in Chemistry are significant. Therefore MGO, VLS, PAPGO and MA are significant predictors of BPS in Chemistry for Urban sample.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of MGO, VLS, PAPGO and MA can be represented as BPS = 19.07 + 0.604MGO + 0.314VLS + 0.268PAPGO + 0.199MA. This equation suggests that, for every unit increase in MGO, the increase in BPS is 0.604 units when the effects of PAPGO, MA and VLS are held constant and that for unit increase in the VLS the Basic Process Skills is increases by 0.314 units, only when the effect of the variable MGO, MA and PAPGO are nullified. Similarly for the unit increase in the PAPGO the Basic Process Skill is increased by 0.268 units only when the effects of MGO, VLS and MA are nullified and for every unit increase in the predictor MA the Basic Process Skill is increased by 0.199 units when the effects of MGO, VLS and PAPGO are held constant.

Hence, out of seven Predictor Variables; only four variables are emerged as the significant predictors and therefore four models are derived out of the Stepwise Regression Analysis. ***MGO, VLS, PAPGO, and MA are the predictors having significant influence (individually and collectively) on BPS of Urban students;*** whereas the Predictors; PAVGO, ALS and KLS are not influencing the BPS in Chemistry of Urban Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS in Predicting the Criterion Variable; Basic Process Skills in Chemistry for the Rural Sample.

In this section of the analysis the investigator has employed Multiple Regression analysis for the Rural sample. The data of the inter-correlation of Criterion variable with seven Predictor Variables are given in Table 52.

Table 52

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, and KLS) for Rural Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.064^{ns}	1.000						
MGO	.392**	-.081	1.000					
PAPGO	.212**	.168	.096	1.000				
PAVGO	-.084*	.044	-.078	-.033	1.000			
VLS	.028^{ns}	.187	.003	.269	-.006	1.000		
ALS	-.063^{ns}	-.023	-.059	-.009	.061	.175	1.000	
KLS	.047^{ns}	.089	.053	.197	-.020	.322	.324	1.000

Note: **indicates p<.01; *indicates p<.05; ns. indicates not significant

Table 52 reveals the Pearsons' Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables. The computed 'r' values for the predictor variables; MA (r = .064, p>.01), MGO, (r = .392, p<.01), PAPGO (r = .212, p<.01), PAVGO (r = -.084, p<.05), VLS (r = .028, p=ns), ALS (r = -.063, p=ns) and KLS (r = .047, p=ns) respectively. The Coefficient of Correlation (r) value reported for MGO and PAPGO verified significant and found positively associated with Basic Process Skills in Chemistry, whereas the predictor; PAVGO shows significant negative association with BPS. The Pearson's r for the variables MA, VLS, ALS and KLS shows no association with BPS in the case of Rural students.

Hence the correlation matrix implied that the Predictor Variables; MGO and PAPGO shows substantial or marked linear relation with Basic Process Skills in Chemistry; whereas the Predictor, PAVGO shows significant negative relation (non-linear) with BPS for Rural Sample.

a) *Model Summary of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Rural Sample.*

The model summary of the analysis with Multiple Correlation Coefficient (*R*), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages for Rural sample are given in the Table 53.

Table 53

Model Summary for Regression of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Rural Sample

Model	*R*	R^2	Adjusted R^2	R^2Change	Standard Error of the Estimate
1	.392	.154	.152	.154	14.042
2	.430	.184	.181	.031	13.791

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*

   Criterion Variable: BPS

Table 53 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (*R*) for first and second models are .392 and .430 respectively. The Coefficient of Determination (R^2) for first and second models are .154 and .184 respectively. The detailed interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO and PAPGO to the Criterion Variable is shown in Table 54.

Table 54

ANOVA Summary for Regression of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Rural Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	18185.804	1	18185.804	
	Residual	100182.831	508	197.210	92.215**
	Total	118368.635	509		
2	Regression	21836.608	2	10918.304	
	Residual	96532.027	507	190.398	57.344**
	Total	118368.635	509		

Note: **indicates $p<.01$

From Table 53 and Table 54, two models are derived, which exhibit the relative contribution of each Predictor Variables (individual and combined) on the Criterion Variable. Among the Predictor Variables, MGO has the highest correlation (r = .392) with BPS, therefore it was selected to enter first in the analysis. Among the Predictor Variables; MGO and PAPGO which shows substantial or marked relation with BPS in Chemistry are found to be emerged as the significant predictors in the regression models and the predictor PAVGO having negative significant association with BPS is found to be excluded from the derived models. It is eliminated because almost all of its shared variability with BPS overlaps with that of other predictors entered in the model being tested. The interpretation and discussion regarding emerged models are as follows.

From the derived regression Model 1, it is clear that when the Predictor Variable; MGO was taken against the BPS, that yielded a Coefficient of Multiple Correlations (R) of .392 and the Standard Error of the estimate (SE_R) is 14.04.The Multiple Correlation Square (R^2) of Model 1 is

.154 and the Adjusted R^2 is .152. The R^2 value implied that 15.4% of the observed variance in the BPS scores is accounted by the MGO because this model presents the sole contribution by MGO. The corresponding *F* value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 =.154, $F(1, 508) = 92.21$, $p<.01$) as the obtained value exceed the tabled value of *F* ($F(1, 508) = 6.66$).

In this model, the values of R^2 and R^2 change are equal because this model contains the influence of a single predictor. It is therefore concluded that the MGO is identified as the most potential predictor and contributes significantly to the model developed for BPS in Chemistry for Rural Secondary School Students.

With respect to the Model 2, derived out of regression explains whether there exist any significant increases in the shared common variance accounted by the next predictor variable, PAPGO to the BPS. In this model, when MGO and PAPGO are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (*R*) of .430 and the Standard Error of the Estimate (SE_R) is 13.79. The Multiple Correlation Square (R^2) of Model 2 is .184 and the adjusted R^2 is .181. The R^2 implied that 18.4% of the observed variance in the BPS scores is accounted by the collective contribution of MGO and PAPGO. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .184, $F(2, 507) = 57.34$, $p<.01$) since the calculated *F*- value exceeds the tabled value of *F* ($F(2, 507) = 4.62$).

The value of R^2 change is .031 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 3.1%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the BPS of high school Rural Students in Chemistry subject.

b) Coefficient Summary of the Predictor Variables MGO and PAPGO on Basic Process Skills in Chemistry for the Rural Sample.

To know the individual contribution of the significant Predictor Variables, the Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 55.

Table 55

Coefficient Summary for Regression of the *Predictor Variables MGO and PAPGO on Basic Process Skills in Chemistry for the Rural Sample*

Model		Unstandardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	21.210	5.588		
	MGO	.743	.077	.392	9.603**
2	(Constant)	1.649	7.576		
	MGO	.711	.076	.375	9.307**
	PAPGO	.343	.078	.176	4.379**

Note: **indicates $p<.01$

Table 55 shows that for the derived Model 1, the Unstanderdised Beta Coefficient (B) of MGO is 0.743 and the Standard Error of B is 0.077. Further 'β' value presents Standardized Regression weight for MGO and which is found to be as 0.392. The critical ratio for the B and the beta value for MGO is statistically highly significant (t = 9.60, p<.01). It means that the individual contribution of MGO in predicting BPS in Chemistry of Rural students is significant and the percentage of contribution of MGO to BPS is 15.4%. Therefore, MGO is the most significant positive predictor of BPS in Chemistry of Rural Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the predictor variables MGO can be written as BPS = 21.21 + 0.74MGO. This equation suggests that for 0.74 unit increase the Basic Process Skills in Chemistry for Rural sample can be significantly predicted for every unit increase in MGO for this model.

Table 55 shows that for the Model 2, the Unstanderdised Beta Value (B) weight of this variable in writing the regression equation is 0. 711 for MGO and that of PAPGO is .343. The value of Standard Error of B for MGO is 0.076 and that of PAPGO is 0.078. Further β value presents Standardized Regression weight for MGO is 0.375 and that of PAPGO is 0.176. The critical ratios for the B and beta values for MGO (t = 9.30) and PAPGO (t = 4.37) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting BPS in Chemistry for Rural students are highly significant and the percentage of individual contributions of MGO and PAPGO are 15.4% and 3.1% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of BPS in Chemistry for Rural Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the Predictor Variables MGO and PAPGO can be written as

BPS = 1.649 + 0.711MGO + 0.343PAPGO. This equation suggests that for every unit increase in MGO, the increase in BPS is 0.711 units when the effects of PAPGO is held constant and for every unit increase in the PAPGO the Basic Process Skills is increases by 0.343 units, only when the effect of the variable MGO is nullified.

In brief, it can be said that, out of seven Predictor Variables only two variables are emerged as the significant predictors and therefore two models are derived out of the Stepwise Regression Analysis. ***MGO and PAPGO are the predictors having significant influence (individually and collectively) on BPS for Rural students;*** whereas the Predictors; MA, PAVGO, VLS, ALS and KLS are not influencing the BPS in Chemistry of Rural Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS in Predicting the Criterion Variable; Basic Process Skills in chemistry for Government Sample.

In this section of the analysis the investigator has used Multiple Regression Analysis for Government sample. The data of the inter-correlation of Criterion Variable with seven Predictor Variables for Government Sample are given in Table 56.

Table 56

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) on the Predictor Variables (MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS) for the Government Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	.119**	1.000						
MGO	.384**	-.053	1.000					
PAPGO	.118**	.061	.095	1.000				
PAVGO	-.015^{ns}	.049	-.083	-.121	1.000			
VLS	.079*	.159	-.009	.276	-.089	1.000		
ALS	-.094*	.058	-.067	.031	.041	.270	1.000	
KLS	.039^{ns}	.171	.064	.176	-.040	.352	.325	1.000

Note: **indicates p<.01; *indicates p<.05; ns. indicates not significant

Table 56 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables. The computed 'r' value of Government students for the Variables MA (r = .119, p<.01), MGO (r = .384, p<.01), PAPGO (r = .118, p<.01) and VLS (r = .079, p<.05) are verified as significant and found positively associated with Basic Process Skills in Chemistry. The index of correlation reported for the variable; ALS is (r = -.094, p<.05) indicates significant negative relation with BPS. But the predictors; PAVGO (r = -.015, p=ns) and KLS (r = .039, p=ns) shows no significant realtionship with BPS.

Hence the correlation matrix revealed that the Predictor Variables; MGO, MA, VLS, and PAPGO which shows substantial or marked linear relation with Basic Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non-linear) with BPS for the Governement Sample.

The model summary of the analysis with Multiple Correlation Coefficient (*R*), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages for Government sample are given in the Table 57.

Table 57

Model Summary for Regression of the Predictor Variables; MGO, MA, VLS, and PAPGO on Basic Process Skills in Chemistry for the Government Sample

Model	*R*	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.384	.147	.145	.147	15.082
2	.408	.167	.162	.019	14.931
3	.420	.176	.170	.010	14.863
4	.433	.187	.179	.011	14.782

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, MA*
3. *Predictors: (Constant), MGO, MA, VLS*
4. *Predictors:(Constant),MGO, MA, VLS, PAPGO*

Criterion Variable: BPS

Table 57 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (*R*) for first, second, third and forth models are .384, .408, .420 and .433 respectively. The Coefficient of Determination (R^2) for first, second, third and forth models are .147, .167, .176 and .187 respectively. The detailed interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the Predictor Variables; MGO, MA, VLS, and PAPGO to the Criterion Variable; BPS for Government students are shown Table 58.

Table 58

ANOVA Summary for Regression of the *Predictor Variables; MGO, MA, VLS, and PAPGO on Basic Process Skills in Chemistry for the Government Sample*

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	15661.482	1	15661.482	68.820**
	Residual	90800.868	399	227.571	
	Total	106462.349	400		
2	Regression	17731.572	2	8865.786	39.767**
	Residual	88730.777	398	222.942	
	Total	106462.349	400		
3	Regression	18781.780	3	6260.593	28.347**
	Residual	87680.569	397	220.858	
	Total	106462.349	400		
4	Regression	19932.294	4	4983.074	22.805**
	Residual	86530.055	396	218.510	
	Total	106462.349	400		

Note: **indicates $p<.01$

From Table 57 and Table 58, points that four models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with the Criterion Variable. Among the Predictor Variables, MGO has the highest correlation (r = .384) with the BPS and hence it was selected to enter first in the analysis. From the regression Model summary, it is clear that the Predictors; MGO, MA, VLS, and PAPGO which shows substantial or marked relation with BPS in Chemistry are found to be emerged in the regression Models but the predictor; ALS with significant relation with BPS is found to be excluded from the regression Models along with PAVGO and KLS.The interpretation and discussion regarding emerged Models are as follows.

With respect to the derived Model 1, it is clear that when MGO taken against the Criterion Variable (Y), that yielded a Coefficient of Multiple Correlations (R) of .384 and the Standard Error of the Estimate (SE_R) is 15.08. The Coefficient of Determination (R^2) of Model 1 is .147 and the Adjusted R Square is .145. The R^2 value implied that 14.7% of the observed variance in the BPS scores is accounted by MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .147, $F(1, 399)$ = 68.82, $p< .01$) as the obtained value exceed the tabled value of F (F (1, 399) = 6.66).

While considering the Model 2, derived out of regression, it shows whether there exist any significant increases in the amount of variance accounted by the next predictor variable, MA to the BPS. In this model, when MGO and MA are collectively taken against BPS, which yielded a Coefficient of Multiple Correlations (R) of .408 and the Standard Error of the Estimate (SE_R) is 14.93. The coefficient of Determination (R^2) of Model 2 is .167 and the Adjusted R Square is .162. The R^2 value implied that 16.7% of the observed variance in the BPS scores in Chemistry is accounted by the collective contribution of MGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .167, $F(2, 398)$ = 39.76, $p<.01$) since the calculated F- value exceeds the tabled value of F (F (2, 398) = 4.62).

The value of R square change is .019 which indicates that the increase in percentage variance accounted for the variable MA to MGO is 1.9%. This suggests that the predictor MA is also significantly contributing to the model 2 along with MGO. In this model the MA emerged as the second predictor next to MGO in the sequence of predicting the Basic Process Skills of Government high school students in Chemistry subject.

The Model 3 derived from the Regression Analysis revealed the significant increase of the amount of variance accounted by VLS to the BPS. In this model, when MGO, MA and VLS are collectively taken against the BPS, which yielded a Coefficient of Multiple Correlations (R) of .420 with a Standard error of the Estimate (SE_R) of 14.86. The Multiple Correlation Square (R^2) of Model 3 is .176 and the Adjusted R Square is .170. The R^2 value explained that 17.6% of the observed variance in the Basic Process Skill scores is accounted by the collective contribution of MGO, MA and VLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 =.176, $F(3, 397) = 28.34$, $p<.01$) since the calculated F- value exceeds the tabled value of F ($F(3, 397) = 3.80$).

The value of R^2 change is .010 which indicates that the increase in percentage variance accounted for the variable VLS to MGO and MA is 1.0%. This model suggests that the predictor VLS is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and MA for predicting the BPS of Government high school students.

The last model (Model 4) derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, PAPGO to the BPS. In this model, when MGO, MA, VLS and PAPGO are collectively taken against the BPS, yielded a

Coefficient of Multiple Correlations *(R)* of .433 and the Standard Error of the Estimate is (SE_R) 14.78. The Multiple Correlation Square (R^2) of Model 4 is 0.187 and the Adjusted R^2 is 0.179. The R^2 value translated into 18.7% of the observed variance in the Basic Process Skill scores is accounted by the collective contribution of MGO, MA, VLS and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 =.187, F(4, 396) = 22.80, p<.01) since the calculated F-value exceeds the tabled value of F (F(4, 396) =3.34).

The value of R^2 change is .011 indicates that the increase in percentage variance accounted for the variable PAPGO to MGO, MA and VLS is 1.1%. This suggests that the predictor PAPGO is also significantly contributing to the derived model and it is the least predictor which comes last in the sequential order for predicting the BPS of Government High School Students.

c) Coefficient Summary of the Predictor Variables; MGO, MA, VLS, and PAPGO on Basic Process Skills in Chemistry for the Government Sample.

To understand the role of the individual Predictor Variables, the Standardized (Beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 59.

Table 59

Coefficient Summary for Regression of the Predictor Variables; MGO, MA, VLS, and PAPGO on Basic Process Skills in Chemistry for the Government Sample

Model		Un standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	Beta	
1	(Constant)	31.834	4.992		
	MGO	.577	.070	.384	8.296**
2	(Constant)	13.739	7.725		
	MGO	.588	.069	.391	8.530**
	MA	.226	.074	.140	3.047**
3	(Constant)	26.519	9.668		
	MGO	.588	.069	.391	8.568**
	MA	.252	.075	.156	3.370**
	VLS	.195	.089	.101	2.181*
4	(Constant)	16.549	10.552		
	MGO	.572	.069	.380	8.334**
	MA	.248	.075	.153	3.333**
	VLS	.252	.092	.130	2.733*
	PAPGO	.214	.093	.109	2.295*

Note: **indicates $p<.01$; *indicates $p<.05$

Table 59 shows that for the derived Model 1, the Unstanderdised Regression Coefficients (*B*) weight of this variable in writing the regression equation is 0.577 and the Standard Error of B is 0.070. Further 'β' value presents Standardized Regression weight for MGO and which is found to be as 0.384. The critical ratio for the *B* and beta value for MGO is statistically highly significant (t = 8.29, p<.01). It means that the individual contribution of MGO in predicting BPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 14.7%. Therefore MGO is the most significant positive predictor of BPS in Chemistry of Government Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the predictor variables MGO for Model 1, can be written as BPS = 31.83 + 0.577MGO.This equation suggests that for every unit increase in the variable MGO the BPS in Chemistry is increased by 0.577 units for this model.

Table 59 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight of variables in writing the regression equation is 0.588 for MGO and that of MA are 0.226. The value of Standard Error of *B* for MGO 0.069 and that of MA is 0.074. Further 'β' value presents Standardized Regression weight for MGO is 0.391 and that of MA is 0.140.The critical ratio for the beta values for MGO (t = 8.53) and MA (t = 3.04) are statistically significant (p<.01). It means that the individual contributions of MGO and MA in predicting BPS in Chemistry are highly significant and the percentage of individual contributions of MGO and MA are 14.7% and 1.9% respectively. Hence the predictors MGO and MA are identified as the significant positive predictors of BPS in Chemistry for Government students.

For Model 2, the equation to the regression line for predicting BPS in Chemistry by means of the Predictor Variables MGO and MA can be written as BPS = 13.73 + 0.588MGO + 0.226MA. This equation suggests that for 0.588 unit increase in the BPS in Chemistry can be significantly predicted for every unit increase in MGO score when the effects of MA is held constant and that for every unit increase in the MA the BPS is increases by 0.226 units, only when the effect of the variable MGO is nullified.

Table 59 shows that for the Model 3, the Unstanderdised Regression Coefficient (*B*) weight of these variables in writing the regression equation is

0.588 for MGO, 0.252 for MA and that of VLS is 0.195. The value of Standard Error of B for MGO is 0.069, MA is 0.075 and that of VLS is 0.084. Further 'β' value presents Standardized Regression weight for MGO and which is found to be for MGO is 0.391, MA is 0.156 and that of VLS is 0.104. The critical ratios for the beta values for MGO (t = 8.56), MA (t = 3.37), and VLS (t = 2.58) are statistically highly significant (p<.01). It means that the individual contributions of MGO, MA and VLS in predicting the BPS in Chemistry is significant and the corresponding percentages are 14.7%, 1.9% and 1.0% respectively. Therefore MGO, MA and VLS are Positive significant predictors of significant BPS in Chemistry of Government Secondary School Students.

For Model 3, the equation to the regression line for predicting Process Skills in Chemistry by means MGO, MA and VLS can be written as BPS = 26.51 + 0.588MGO + 0.252MA + 0.195VLS. This equation suggests that for 0.588 unit increase in BPS can be significantly predicted for every unit increase in MGO score when the effects of MA and VLS is held constant and that for every unit increase in the MA the Basic process skills is increased by 0.252 units, only when the effect of the variables MGO and VLS is nullified. Similarly for every unit increase in the VLS, the BPS is increased by 0.195 units when the effects of MGO and MA are held constant.

Table 59 gives the Unstanderdised Regression Coefficient (B) weight of the variables in writing the regression equation as 0.572 for MGO, 0.248 for MA, VLS is 0.252 and that of PAPGO is 0.214. The value of Standard Error of 'B' for MGO is 0.069, MA is 0.075, VLS is 0.092 and that of PAPGO is 0.093. Further 'β' value presents Standardized Regression weight for MGO is

0.380, MA is 0.153, VLS is 0.130 and that of PAPGO is 0.109. The critical ratios for the *B* and the beta values for MGO (t = 8.33), MA (t = 3.33), VLS (t = 2.73) and PAPGO (t = 2.29) which are statistically highly significant (p<.01, p<.05). It means that the individual contributions of MGO, MA, VLS and PAGO in predicting the BPS in Chemistry is significant and the percentage of individual contributions are 14.7%, 1.9%. 1.0% and 1.1% respectively. Therefore, MGO, MA, PAPGO and VLS are the significant positive predictors of BPS in Chemistry for Government Secondary School Students.

The equation to the regression line for predicting BPS by means of the Predictor Variables MGO, MA, VLS and PAPGO can be represented as, BPS = 16.54 + 0.572MGO + 0.248MA + 0.252VLS + 0.214PAPGO. This equation suggests that, for every unit increase in MGO the increase in BPS is 0.572 units when the effects of PAPGO, MA and VLS are held constant and that for every unit increase in the MA the Basic Process Skills is increases by 0.248 units, only when the effect of the variable MGO, VLS and PAPGO are nullified. Similarly for every unit increase in the VLS the Basic Process Skill is increased by 0.252 units only when the effects of MGO, MA and PAPGO are nullified. In case of PAPGO, for every unit increase in the predictor PAPGO the Basic Process Skill is increased by 0.214 units when the effects of MGO, MA and VLS are held constant.

In brief, it can be said that that out of seven Predictor Variables only four variables are emerged as the significant predictors and therefore four models are derived out of the stepwise regression analysis. The Predictors; ***MGO, MA, VLS, and PAPGO make significant influence (Individually & collectively) upon BPS in Chemistry of Government Students*** and the

Predictors; PAVGO, ALS and KLS are not influencing the BPS of Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS and KLS in Predicting the Criterion Variable; Basic Process Skills in Chemistry for Aided Students.

In this section of the analysis the investigator has employed Multiple Regression Analysis for the subsample Aided Students. The data of the inter-correlation of Criterion variable with Seven Predictor Variables are given in Table 60.

Table 60

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (BPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for Aided Sample

Variables	BPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
BPS	1.000							
MA	$.050^{ns}$	1.000						
MGO	.365**	-.065	1.000					
PAPGO	.181**	.146	-.009	1.000				
PAVGO	$-.030_{ns}$	-.027	-.045	.052	1.000			
VLS	$.066^{ns}$	.187	-.176	.239	-.015	1.000		
ALS	-.069*	-.051	.003	-.045	.032	.114	1.000	
KLS	$.050^{ns}$	.086	-.017	.151	.051	.284	.309	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 60 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the BPS and the Predictor Variables; MGO (r = .365, p<.01) and PAPGO (r = .181, p<.01) respectively, which indicates significant and positive association with BPS. The indices of correlation reported for MA (r = .050, p=ns), PAVGO (r = -.030, p=ns), VLS (r = .066, p=ns and KLS (r = .050, p=ns) respectively indicates there is no significant association between MA, PAVGO, VLS, and KLS with Basic Process Skills in Chemistry except for ALS (r = -.069, p<.05), which shows a negative significant relationship with BPS for the Aided Students.

Hence the correlation matrix revealed that the Predictor Variables MGO and PAPGO which shows substantial or marked relation with Basic Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non linear) with BPS for the Aided Sample.

a) ***Model Summary of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Aided Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages is represented by for Aided sample are given in the Tabl 61.

Table 61

Model Summary for Regression of the Predictor Variables; MGO and PAPGO on the Criterion Variable; Basic Process Skills in Chemistry for the Aided Sample

Model	R	R^2	Adjusted R^2	R^2Change	Standard Error of the Estimate
1	.365	.133	.132	.133	14.85
2	.409	.167	.164	.034	14.57

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
   Criterion Variable: BPS

Table 61 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first and second models are .365 and .409 respectively.

The Coefficient of Determination (R^2) for first and second models are .133, and .167 respectively. The detailed interpretations of these coefficients are presented in the following section.

The significance of the regression model derived for the predictor Variables; MGO and PAPGO to the Criterion Variable; BPS in Chemistry are shown in Table 62.

Table 62

ANOVA Summary for Regression of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Aided Sample

	Model	Sum of Squares	*df*	Mean Square	*F*
1	Regression	19614.249	1	19614.249	
	Residual	127366.632	577	220.739	88.857**
	Total	146980.881	578		
2	Regression	24580.389	2	12290.194	
	Residual	122400.492	576	212.501	57.836**
	Total	146980.881	578		

Note: **indicates p<.01

From Table 61 and Table 62 shows that two Models are derived, which exhibit the relative contribution of predictor variables (individual and combined) with the Criterion Variables. Among the Predictor Variables, MGO has the highest correlation (r = .365) with BPS, therefore it was selected to enter first in the Models of regression analysis. From the Regression Model summary, it is clear that the Predictors; MGO and PAPGO which shows substantial or marked relation with BPS in Chemistry are found to be emerged in the regression models but the predictor; ALS with significant relation with BPS is found to be excluded from the regression Models along with MA, PAVGO, VLS, ALS and KLS. The interpretation and discussion regarding emerged Models are given below;

From the derived Model 1, it is clear that the Predictor Variable; MGO taken against the Criterion Variable (BPS), yielded a Coefficient of Multiple Correlations (R) of .365 with a Standard Error of the Estimate (SE_R) of 14.85. The Coefficient of Determination (R^2) of Model 1 is .133 and the Adjusted R Square is .132. The R^2 value implied that 13.3% of the observed variance in the BPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .133, $F(1, 577)$ = 88.85, $p<.01$) as the obtained value exceed the tabled value of F ($F(1, 577)$ = 6.66).

In this model the values of R^2 and R^2 change are equal because this model contains the influence of a single predictor. It is therefore concluded that the MGO is identified as the most potential predictor and contributes significantly to the model developed for the Criterion Variable; BPS in Chemistry for Aided Secondary School Students.

The Model 2, derived out of regression shows whether there exist any significant increases in the shared common variance accounted by the next Predictor Variable, PAPGO to the BPS. In this model, MGO and PAPGO are collectively taken against the BPS, yielded a Coefficient of Multiple Correlations (R) of .409 with a Standard Error of the Estimate (SE_R) of 14.57. The Multiple Correlation Square (R^2) of Model 2 is .167 and the Adjusted R

Square is .164. The R^2 value translated into 16.7% of the observed variance in the BPS scores is accounted by the collective contribution of MGO and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .167, F(2, 576) = 57.83, p<.01) since the calculated F- value exceeds the tabled value of F (F (2, 576) = 4.62).

The value of R^2 Change is .034 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 3.4%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO is emerged as the second predictor next to MGO in the sequence of predicting the BPS of high school Aided students in Chemistry Subject.

b) Coefficient Summary of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Aided Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (B) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 63.

Table 63

Coefficient Summary for Regression of the Predictor Variables; MGO and PAPGO on Basic Process Skills in Chemistry for the Aided Sample

	Model	Un standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	Beta	
1	(Constant)	7.255	7.148		
	MGO	.937	.099	.365	9.426**
2	(Constant)	20.236	9.029		
	MGO	.941	.097	.367	9.650**
	PAPGO	.370	.077	.184	4.834**

Note: **indicates p<.01; *indicates p<.05

Table 63 shows that for the derived Model 1, the Unstanderdised Regression Coefficients (B) weight of this variable in writing the regression equation is 0.937 and the Standard Error the Estimate of B is 0.099. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.365. The critical ratio for the B and the beta value is statistically highly significant (t = 9.42, P<.01). It means that the individual contribution of MGO in predicting BPS in Chemistry of Aided students is significant and the percentage of contribution of MGO to BPS is 13.3%. Therefore MGO is the most significant positive predictor of BPS in Chemistry for Aided Secondary School Students.

For Model 1, the equation to the regression line for predicting BPS in Chemistry (Y) by means of the predictor variables MGO can be written as BPS = 7.255 + 0.937MGO . This equation suggests that for 0.937 unit increase the BPS in Chemistry can be significantly predicted for every unit increase in MGO score for Aided Secondary Students.

Table 63 shows that for the Model 2, the Unstanderdised Regression (*B*) weight of this variable in writing the regression equation is 0.941 for MGO and that of PAPGO is 0.370. The value of Standard Error of *B* for MGO is 0.097 and that of PAPGO is 0.077. Further β value presents Standardized Regression weights which are found to be as; for MGO it is 0.367 and that of PAPGO is 0.184. The critical ratios of the *B* and beta values of MGO (t = 9.65) and PAPGO (t = 4.83) statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting BPS in Chemistry for Aided students are highly significant and the percentage of individual contributions of MGO and PAPGO are 13.3% and 3.4% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of BPS in Chemistry for Aided Secondary School Students.

The equation to the regression line for predicting BPS in Chemistry (Y) by means of the predictor variables MGO and PAPGO for Model 2, can be written as BPS = 20.236 + 0.941MGO + 0.370PAPGO. This equation suggests that for every unit increase in MGO, the increase in BPS is 0.941 units when the effects of PAPGO is held constant and that for every unit increase in the PAPGO, the BPS is increases by 0.370 units, only when the effect of the variable MGO is nullified.

Hence, the results can be summarised as, out of seven Predictor Variables only two Variables are emerged as the significant predictors and therefore two Models are derived out of the stepwise regression analysis. ***MGO and PAPGO are the significant predictors having significant influence (individually and collectively) on BPS of Aided students;*** whereas the Predictors; MA, PAVGO, VLS, ALS and KLS are not influencing the BPS in Chemistry of Aided Secondary School Students.

Multiple Regression Analysis for Integrated Process Skills

This section of the study identifies the individual and joint contribution of Metacognitive Awareness, Goal Orientation and Learning Styles in predicting Integrated Process Skills in Chemistry of Secondary School Students. The identification of the significant Predictors from the selected predictor Variables; Metacognitive Awareness, Goal Orientation (Mastery Goal Orientation, Performance-Approach Goal Orientation, and Performance-Avoidance Goal orientation), and Learning Styles (Visual Learning Style, Auditory learning Style, and Kinesthetic Learning Style) with the detailed interpretation regarding regression models derived for each sample is detailed in this section. The whole analysis was carried out for the Total sample and the subsamples based on Gender, Locale and Type of Management and this has been done using SPSS programme. The details of the analysis are presented as follows.

Relative Efficiency of Predictor Variables; MGO, PAPGO, MA, VLS, ALS, and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for Total Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis with Predictors; Metacognitive Awareness, Mastery Goal Orientation, Performance-Approach Goal Orientation, Performance-Avoidance Goal Orientation, Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style and Integrated Process Skills in Chemistry

(IPS) as Criterion Variable for the Total Sample. The data of the inter-correlation of Criterion variable with seven Predictor Variables are given in Table 64.

Table 64

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables; MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS for the Total Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.147**	1.000						
MGO	.406**	-.057	1.000					
PAPGO	.194**	.111	.046	1.000				
PAVGO	-.050^{ns}	.006	-.065	-.023	1.000			
VLS	.087*	.173	-.079	.252	-.046	1.000		
ALS	-.101**	-.008	-.033	-.014	.036	.174	1.000	
KLS	.098**	.124	.028	.163	.010	.310	.315	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 64 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA (r = .147, p<.01), MGO, (r = .406, p<.01), PAPGO, (r = .194, p<.01), VLS (r = .087, p<.01), ALS (r = -.101, p<.01) and KLS (r = -.098, p<.01) respectively, which indicates significant association of these variables with Integrated Process Skills in Chemistry. Among the Predictor Variables; ALS shows negative association with IPS and all others show positive relation with IPS and the Predictor PAVGO (r = .050, p=ns) show no significant relation with IPS for Total Sample.

Hence the correlation matrix revealed that the Predictor Variables; MGO, PAPGO, MA, VLS, and KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the

Predictor ALS shows significant negative relation (non-linear) with IPS in Chemistry for the Total Sample.

a) ***Model Summary of the Predictor Variables; MGO, PAPGO, MA, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for the Total Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (*R*), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages on IPS for Total sample are given in the Table 65.

Table 65

Model Summary for Regression of the Predictor Variables; MGO*, PAPGO, MA, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for Total Sample*

Model	*R*	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.406	.165	.164	.165	15.791
2	.442	.195	.194	.031	15.506
3	.467	.218	.216	.023	15.291
4	.475	.226	.222	.007	15.227
5	.480	.230	.226	005	15.188
6	.489	.239	.234	.009	15.110

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
4. *Predictors:(Constant),MGO, PAPGO, MA, VLS*
5. *Predictors:(Constant),MGO, PAPGO, MA, VLS, ALS*
6. *Predictors:(Constant),MGO, PAPGO, MA, VLS, ALS, KLS*
   Criterion Variable: IPS

Table 65 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation

Coefficient (*R*) for first, second, third fourth, fifth and sixth models are .406, .442, .467, .475, .480 and .489 respectively. The Multiple Coefficient of Determination (R^2) for first, second, third fourth, fifth and sixth models are 0.165, 0.195, 0.218, 0.226, 0.230 and 0.239 respectively. The details of interpretation have been done in the following section.

The significance of the regression model derived for the Predictor Variables; MGO, PAPGO, MA, VLS, ALS, and KLS to the Criterion Variable IPS for Total sample are shown in Table 66.

Table 66

ANOVA Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for Total Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	48063.147	1	48063.147	
	Residual	243871.827	978	249.358	192.748**
	Total	291934.974	979		
2	Regression	57005.258	2	28502.629	
	Residual	234929.717	977	240.460	118.534**
	Total	291934.974	979		
3	Regression	63729.214	3	21243.071	
	Residual	228205.761	976	233.817	90.853**
	Total	291934.974	979		
4	Regression	65843.181	4	16460.795	
	Residual	226091.793	975	231.889	70.986**
	Total	291934.974	979		
	Regression	67256.108	5	13451.222	
	Residual	224678.867	974	230.676	58.312**
	Total	291934.974	979		
6	Regression	69774.704	6	11629.117	
	Residual	222160.271	973	228.325	50.932**
	Total	291934.974	979		

Note: **indicates p<.01

From Table 65 and Table 66, shows that six models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with the Criterion Variable. Hence the Predictor Variables; MGO, PAPGO, MA, VLS, ALS and KLS shows substantial or marked relation with Integrated Process Skills in Chemistry are emerged in the regression models. But PAPGO shows no significant correlation with IPS is found to be exclude from the regression models. Among the Predictor Variables, Mastery Goal Orientation (MGO) has the highest correlation (r = .406) with the Criterion Variable (IPS) and hence it was selected to enter first in the analysis. The interpretation and discussion regarding emerged models are as follows.

From the derived Model 1, it is clear that the Predictor Variable; Mastery Goal Orientation (MGO) taken against the Criterion Variable (Y), yielded a Coefficient of Multiple Correlations (R) of .46 with a Standard Error of the Estimate (SE_R) of 15.79. The Coefficient of Determination (R^2) of Model 1 is .165 and the Adjusted R Square is .164. The R^2 value implied that 16.5% of the observed variance in the IPS scores in Chemistry is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .165, $F(1, 978)$ = 192.74, p<.01) as the obtained value exceed the tabled value of F (F(1, 978) = 6.66).

In this model the values of R^2 and R^2 change are equal because this model contains the influence of MGO alone. It is therefore concluded that the MGO is identified as the most potential predictor and contributes significantly to the model developed for the Criterion Variable; Integrated Process Skills in Chemistry for Total Sample.

The Model 2, derived out of regression explains whether there exist any significant increases in the amount of variance accounted by the next predictor variable, PAPGO to the IPS. In this model, when the Predictor Variable; when Mastery Goal Orientation (MGO) and Performance-Approach Goal Orientation (PAPGO) are collectively taken against the Criterion Variable (IPS), that yielded a Coefficient of Multiple Correlations (*R*) of .442 with a Standard Error of the Estimate (SE_R) of 15.50. The Coefficient of Determination (R^2) of Model 2 is .195 and the Adjusted *R* Square is .194. The R^2 value implied that 19.5% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and PAPGO. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .195, $F(2, 977) = 118.53$, $p<.01$), since the calculated F- value exceeds the tabled value of *F* ($F(2, 977) = 4.62$).

The value of R^2 change is 0.031 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 3.1%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the Integrated Process Skills of secondary School Students in Chemistry Subject.

With respect to the Model 3, derived from the regression shows the significant increase in the amount of variance accounted by the next predictor variable, MA to the BPS. In this model, when the Predictor Variables Mastery Goal Orientation (MGO) Performance-Approach Goal Orientation (PAPGO) and Metacognitive Awareness (MA) are collectively taken against the Criterion Variable (IPS), yielded a Coefficient of Multiple

Correlations (*R*) of .467 with a Standard Error of the Estimate (SE_R) of 15.29. The Multiple Correlation Square (R^2) of Model 3 is .218 and the Adjusted *R* Square is .216. The R^2 implied that 21.8% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 = .218, $F(3, 976)$ =90.853, p<.01) since the calculated F- value exceeds the tabled value of *F* ($F(3, 976)$ = 3.80).

The value of R^2 Change is .023 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is 2.3%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequential order i.e. after MGO and PAPGO for predicting the Integrated Process Skills of High School Students.

While considering the fourth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next Predictor Variable, VLS to the IPS. In this model, the Predictor Variables; Mastery Goal Orientation (MGO) Performance-Approach Goal Orientation (PAPGO), Metacognitive Awareness (MA) and Visual learning style (VLS) are collectively taken against the Criterion Variable (IPS), which yielded a Coefficient of Multiple Correlations (*R*) of .475 with a Standard Error of the Estimate (SE_R) of 15.22. The Coefficient of Determination (R^2) of Model 4 is .226 and the Adjusted R^2 is 0.221. The R^2 value revealed that 22.6% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, MA and VLS. The value of F obtained by the ANOVA method for the given *R* in the Model

4 is significant (R^2 = .226, F(4, 975) = 70.9, p<.01) since the calculated F- value exceeds the tabled F value (F(4, 975) = 3.34).

The value of R^2 Change is .007 which indicates that the increase in percentage variance accounted for the variable VLS to MGO, PAPGO and MA is 0.7%. This suggests that the predictor VLS is also significantly contributing to the derived model and which comes forth in the sequential order for predicting the IPS of High School Students.

The fifth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, ALS to the IPS. In this model, the Predictor Variables; MGO, PAPGO, MA, VLS and ALS are jointly taken against the IPS, which yielded a Coefficient of Multiple Correlations (R) of .480 with a Standard Error of the Estimate (SE_R) of 15.18. The Coefficient of Determination (R^2) of Model 4 is .230 and the Adjusted R Square is .226. The R^2 value implied that 23.0% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, MA, VLS and ALS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 = .230, F(5, 974) = 58.312, p<.01) since the calculated F- value exceeds the tabled value of F (F(5, 974) = 3.04).

The value of R^2 Change is .005 which indicates that the increase in percentage variance accounted for the variable ALS to MGO, PAPGO, MA and VLS is 0.5%. This suggests that the predictor ALS is also significantly contributing to the derived model and which comes fifth position in the sequential order for predicting the Integrated Process Skills of high school Students.

With respect to the sixth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, KLS to the IPS. In this model the Predictor Variables; MGO, PAPGO, MA, VLS, ALS and KLS are jointly taken against the Criterion Variable (IPS), which yielded a Coefficient of Multiple Correlations (*R*) of .489 with a Standard Error of the Estimate (SE_R) of 15.11. The Multiple Correlation Square (R^2) of Model 4 is .239 and the Adjusted *R* Square is .234. The R^2 value implied that 23.9% of the observed variance in the Integrated Process Skill scores is accounted by the collective contribution of MGO, PAPGO, MA, VLS, ALS and KLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 6 is significant (R^2 =.239, $F(6, 973)$=50.932, p<.01), since the calculated F-value exceeds the tabled value of F ($F(6, 973)$= 2.82).

The value of R^2 Change is .009 which indicates that the increase in percentage variance accounted for the variable KLS to MGO, PAPGO, MA, VLS and KLS is 0.9%. This suggests that the predictor KLS is also significantly contributing to the derived model and which comes sixth position in the sequential order for predicting the Integrated Process Skills of high school students.

b) ***Coefficient Summary of the Predictor Variables; MGO, PAPGO, MA, VLS, ALS and KLS on Integrated Process Skills in Chemistry for the Total Sample.***

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 67.

Table 67

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, VLS, ALS and KLS on Integrated Process Skills in Chemistry for the Total Sample

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	8.149	4.304		
	MGO	.831	.060	.406	13.883**
2	(Constant)	18.239	6.049		
	MGO	.815	.059	.398	13.839**
	PAPGO	.374	.061	.175	6.098**
3	(Constant)	36.843	6.900		
	MGO	.834	.058	.407	14.344**
	PAPGO	.337	.061	.158	5.530**
	MA	.262	.049	.153	5.363**
4	(Constant)	27.016	7.604		
	MGO	.819	.058	.400	14.092**
	PAPGO	.383	.063	.179	6.120**
	MA	.284	.049	.166	5.768**
	VLS	.180	.060	.089	3.019**
5	(Constant)	16.721	8.650		
	MGO	.817	.058	.399	14.085**
	PAPGO	.374	.062	.175	5.986**
	MA	.280	.049	.163	5.691**
	VLS	.153	.061	.076	2.519*
	ALS	-.165	.067	-.071	-2.475*
6	(Constant)	19.603	8.649		
	MGO	.805	.058	.393	13.929**
	PAPGO	.352	.062	.165	5.640**
	MA	.266	.049	.155	5.416**
	VLS	.200	.062	.099	3.228**
	ALS	-.232	.069	-.100	-3.345**
	KLS	.211	.064	.103	3.321**

Note: **indicates *p*<.01; *indicates *p*<.05

Table 67 reveals that for the derived Model 1, the Unstanderdised Regression Coefficients (*B*) weight of the variable; MGO in writing the regression equation is 0.83 and the Standard Error of *B* is 0.06. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.406. The critical ratio for the beta value is statistically highly significant (t = 13.88, p<.01). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 16.5%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Secondary School Students.

For Model 1, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO (X2) is given by Y = 8.149 + 0.831X2 in general form and for the present study the equation can be written as IPS = 8.149 + 0.83MGO. This equation suggests that for 0.831 unit increase in IPS in Chemistry can be significantly predicted for every unit increase in MGO score for this model.

Table 67 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) is 0.815 for MGO and that of PAPGO is 0.314. The value of Standard Error of *B* for MGO is 0.059 and that of PAPGO is 0.061. Further β value presents Standardized Regression weight for MGO and which is found to be as for MGO it is 0.398 and that of PAPGO is 0.175. The critical ratios for the beta values for MGO (t = 13.839) and PAPGO (t = 6.908) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 16.5%

and 3.1% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of IPS in Chemistry.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO (X2) and PAPGO (X3) is Y = 18.289 + 0.815X2 + 0.314X3 in general form and in variable terms it can be written as IPS = 18.289 + 0.815 MGO + 0.314 PAPGO. This equation suggests that for every unit increase in MGO (X2), the increase in IPS is 0.815 units when the effects of PAPGO is held constant and that for every unit increase in the PAPGO (X3) the IPS is increases by 0.314 units, only when the effect of the variable MGO is nullified.

Table 67 shows that for the Model 3, the Unstanderdised Regression Coefficient (*B*) is 0.834 for MGO, 0.337 for PAPGO and that of MA is 0.262. The value of Standard Error of *B* for MGO is 0.058, PAPGO is 0.061 and that of MA is 0.049. Further β value presents Standardized Regression weight for MGO is .407, PAPGO is 0.158 and that of MA is 0.153. The critical ratio for the beta values for MGO (t = 14.34), PAPGO (t = 5.53) and MA (t = 5.36) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the IPS in Chemistry is significant and the corresponding percentages are 16.5%, 3.1% and 2.3% respectively. Therefore MGO, PAPAGO and MA are Positive significant predictors of Integrated Process Skills in Chemistry.

The equation to the regression line for predicting Integrated Process Skills In Chemistry (Y) by means of the predictor variables MGO (X3), PAPGO(X4) and MA(X1) is Y = 36.843 + 0.834X2 + 0.337X3 + 0.262X1 in general form and in variable terms the equation can be written as IPS = 36.843 + 0.834MGO + 0.337PAPGO + 0.262MA. This equation suggests that for every unit increase in MGO can be significantly predicted with an increase in IPS of 0.834 units when the effects of PAPGO and MA is held constant and that for every unit increase in the PAPGO the Integrated Process skills is increased by 0.337 units, only when the effect of the variables MGO and MA is nullified. Similarly for every unit increase in the MA the Integrated Process Skill is increased by 0.262 units when the effects of MGO and PAPGO are held constant.

Table 67 points that in respect of the Model 4, the Unstanderdised Regression Coefficients (*B*) weight is 0.819 for MGO, 0.383 for PAPGO, MA is 0.284 and that of VLS is 0.180. The value of Standard Error of *B* for MGO is 0.058, PAPGO is 0.063, MA is 0.049 and that of VLS is 0.060. Further β value presents Standardized Regression weights for MGO is .400, PAPGO is 0.179, MA is 0.166 and that of VLS is 0.089.The critical ratio for the beta values for MGO (t = 14.09), PAPGO (t = 6.12), MA (t = 5.768) and VLS (t = 3.019) are statistically highly significant (p<.01). It means that the individual contributions of PAGO, MGO, MA and VLS in predicting the Integrated Process Skills in Chemistry is significant and the percentage of individual contributions are 16.5%, 3.1%. 2.3% and 0.7% respectively. Therefore PAGO, MAG, MA and VLS are the significant predictors of IPS in Chemistry of Secondary School Students.

For Model 4, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO(X2), PAPGO(X3), MA(X1) and VLS(X5) is Y = 27.016 + 0.819X2 + 0.383X3 + 0.284X1 + 0.180X5 in general form and in the present case it can be represented as IPS = 27.016 + 0.819MGO + 0.383PAPGO + 0.284MA + 0.180VLS. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.819 units when the effects of PAPGO, MA and VLS are held constant and that for unit increase in the PAPGO the Integrated Process Skills is increases by 0.383 units, only when the effect of the variable MGO, MA and VLS are nullified. Similarly for every unit increase in the MA the Integrated Process Skill is increased by 0.284 units only when the effects of MGO, PAPGO and VLS are nullified. Similarly, for every unit increase in the predictor VLS the Integrated Process Skill is increased by 0.180 units when the effects of MGO, PAPGO and MA are held constant.

Table 67 shows that for the Model 5, the Unstanderdised Regression '*B*' weight is 0.817 for MGO, 0.374 for PAPGO, MA is 0.280, VLS is 0.153 and that of ALS is -0.165. The value of Standard Error of *B* for MGO is 0.058, PAPGO is 0.062, MA is 0.049, VLS is 0.061 and that of ALS is 0.067. Further β value presents Standardized Regression weights for MGO is 0.399, PAPGO is 0.175, MA is 0.163, VLS is 0.076 and that of ALS is -0.071. The critical ratio for the beta values for MGO (t = 14.08), PAPGO (t = 65.98), MA (t = 5.61), VLS (t = 2.51) and ALS (t = 2.475) are highly significant (p<.01 & p<.05). It means that the individual contributions of PAGO, MGO, MA, VLS and ALS in predicting the Integrated Process Skills in Chemistry is significant and the percentage of individual contributions are 16.5%, 3.1%. 2.3%, 0.7% and 0.5% respectively. Therefore PAGO, MAG, MA, VLS and ALS are the significant predictors of IPS in Chemistry of Secondary School Students.

For Model 5, the equation to the regression line for predicting Integrated Process Skills in Chemistry (Y) by means of the Predictor Variables MGO(X2), PAPGO(X3), MA(X1), VLS(X5) and ALS (X6) is Y = 16.721 + 0.817X2 + 0.374X3 + 0.280X1 + 0.153X5 - 0.165X6 in general form and in the present case it can be represented as IPS = 16.721 + 0.817MGO + 0.374PAPGO + 0.280MA + 0.153VLS - 0.165ALS. This equation suggests that for every unit increase in X2 (MGO), the increase in Y is 0.817 units when the effects of X3, X1, X5 and X6 are held constant and that for unit increase in the X3 (PAPGO) the IPS is increased by 0.374 units, only when the effect of the variable X2, X1, X5 and X6 are nullified. Similarly for the unit increase in the X1 (MA) the IPS is increased by 0.280 units only when the effects of MGO, PAPGO, VLS and ALS are nullified. Where as in case of VLS and ALS; for every unit increase in the X2 (VLS) the Integrated Process Skill is increased by 0.180 units when the effects of MGO, PAPGO, MA and ALS are held constant and for every unit decrease in the X3 (ALS) the IPS is increased by 0.165 units when the effects of MGO, PAPGO, MA and VLS are held constant.

Table 67 presents that for the Model 6, the Unstanderdised Regression Coefficient '*B*' weight is 0.805 for MGO, 0.352 for PAPGO, MA is 0.266, VLS is 0.200, ALS is -0.232and that of KLS is 0.211. The value of Standard Error of B for MGO is 0.058, PAPGO is 0.062, MA is 0.049, VLS is 0.062, ALS is 0.069 and that of KLS is 0.103. Further β value presents Standardized Regression weight for MGO and which is found to be as for MGO is 0.393, PAPGO is 0.165, MA is 0.155, VLS is 0.099, ALS is -0.071 and that of KLS is 0.103.The respective critical ratios for the B and the beta values for MGO

(t = 13.92), PAPGO (t = 5.64), MA (t = 5.46), VLS (t = 3.221), ALS (t = 3.345) and KLS (t = 3.321) highly significant (p<.01). It means that the individual contributions of PAGO, MGO, MA, VLS, ALS and KLS in predicting the Integrated Process Skills in Chemistry is significant and the percentage of individual contributions are 16.5%, 3.1%. 2.3%, 0.7%, 0.5% and 0.9% respectively. Therefore PAGO, MAG, MA, VLS, ALS and KLS are the significant predictors of Integrated Process Skills in Chemistry of Secondary School Students.

For Model 6, the equation to the regression line for predicting process skills in chemistry (Y) by means of the predictor variables MGO(X2), PAPGO(X3), MA(X1), VLS(X5), ALS (X6) and KLS (X7) is Y = 19.603 + 0.805 X2 + 0.352 X3 + 0.266X1 + 0.200X5 - 0.232X6 + 0.211X7 in general form and in the present case it can be represented as IPS = 19.603 + 0.805MGO + 0.352 PAPGO + 0.266MA + 0.200VLS - 0.232ALS + 0.211KLS. This equation suggests that for 0.805 unit increase in IPS can be significantly predicted for every unit increase in X2 (MGO), when the effects of X3, X1, X5, X6 and X7 are held constant and that for every unit increase in the X3 (PAPGO) the Integrated Process Skills is increases by 0.352 units, only when the effect of the variable X2, X1, X5, X6 and X7 are nullified. For every unit increase in the X1 (MA) the Integrated Process Skill is increased by 0.266 units only when the effects of MGO, PAPGO, VLS, ALS and KLS are nullified. In case of VLS, the unit increase in the X2 (VLS) the Integrated Process Skill is increased by 0.200 units when the effects of MGO, PAPGO, MA ALS and KLS are held constant and for ALS, for every unit decrease in the X3 (ALS) the Integrated Process Skill is increased by 0.232 units when the effects of

MGO, PAPGO, MA, VLS and KLS are held constant. Similarly for the every unit increase in the KLS (X7) the Integrated Process Skill is increased by 0.211 units only when the effects of MGO, PAPGO, MA, VLS and ALS are nullified.

Hence, it can be summarised that out of seven Predictor Variables; six variables are emerged as the significant predictors and the six models derived exhibits the relative contribution (individual and combined) of each predictor variables with Criterion Variables. Findings revealed that the Predictor Variables; ***MGO, PAPGO, MA, VLS, ALS and KLS are significantly influencing the Integrated Process skills of Secondary students*** whereas the Predictor; PAVGO is not influencing the IPS in Chemistry of Secondary School Students for the Total sample.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, & KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for Male Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis for the Male students with selected Predictor Variables and Integrated Process Skills in Chemistry (IPS) as the Criterion Variable. The data of the inter-correlation of Criterion variable with the seven Predictor Variables are given in Table 68.

Table 68

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables; MA, MGO, PAPGO, PAVG, VLS, ALS, and KLS for the Male Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.102**	1.000						
MGO	.464**	-.121	1.000					
PAPGO	.243**	.105	.105	1.000				
PAVGO	-.084*	.012	-.077	-.044	1.000			
VLS	.002^{ns}	.128	-.076	.259	.016	1.000		
ALS	-.122**	.051	-.076	-.046	.054	.232	1.000	
KLS	.107**	.093	-.013	.134	.030	.297	.325	1.000

Note: **indicates p<.01; *indicates p<.05; ns. indicates not significant

Table 68 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA (r = .102, p<.01), MGO, (r = .464, p<.01), PAPGO, (r = .243, p<.01), PAVGO, (r = -.084, p<.05), ALS (r = -.122, p<.01) and KLS (r = .107, p<.01) indicates significant association with IPS. The computed 'r' for the predictor VLS (r = .002, p=ns), shows that there exist no significant relation with IPS. Among the Predictor Variables; ALS and PAVGO shows negative relation with IPS and all others show positive relation with Integrated Process Skills in Chemistry.

Hence the correlation matrix revealed that the Predictor Variables; MGO, PAPGO, MA, KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS and PAVGO shows significant negative relation (non-linear) with IPS in Chemistry for the Male Sample.

a) ***Model Summary of the Predictor Variables; MGO, PAPGO, MA, ALS, and KLS on Integrated Process Skills in Chemistry for the Male Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages for Male sample are given in the Table 69.

Table 69

Model Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, ALS, and KLS on the Criterion Variable; Integrated Process Skills in Chemistry for the Male Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.464	.216	.214	.216	14.95
2	.504	.254	.250	.038	14.60
3	.522	.273	.267	.019	14.43
4	.529	.280	.273	.007	14.382
5	.541	.293	.284	.013	14.27

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
4. *Predictors:(Constant),MGO, PAPGO, MA, ALS*
5. *Predictors:(Constant),MGO, PAPGO, MA, ALS, KLS*

   Criterion Variable: IPS

Table 69 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first, second, third fourth and fifth models are .464, .504, .522, .529 and .541 respectively. The Coefficient of Determination (R^2) for first, second, third, fourth and fifth models are 0.216, 0.254, 0.273, 0.280 and 0.293 respectively. The detailed interpretations of these coefficients are presented in the following sections.

The significance of the regression model derived the Predictor Variables; MGO, PAPGO, MA, ALS, and KLS to the Criterion Variable are shown in Table 70.

Table 70

ANOVA Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, ALS, and KLS on Integrated Process Skills in Chemistry for Male Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	25228.663	1	25228.663	
	Residual	91712.451	410	223.689	112.785**
	Total	116941.114	411		
2	Regression	29694.312	2	14847.156	
	Residual	87246.802	409	213.317	69.601**
	Total	116941.114	411		
3	Regression	31882.777	3	10627.592	
	Residual	85058.337	408	208.476	50.977**
	Total	116941.114	411		
4	Regression	32755.525	4	8188.881	
	Residual	84185.589	407	206.844	39.590**
	Total	116941.114	411		
	Regression	34227.058	5	6845.412	
5	Residual	82714.056	406	82714.056	33.601**
	Total	116941.114	411	116941.114	

Note: **indicates p<.01; *indicates p<.05; ns. indicates not significant

From Table 69 and Table 70 shows that five models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with IPS. Hence the Predictor Variables; MGO, PAPGO, MA, ALS and KLS shows substantial or marked relation with IPS in Chemistry are found to be emerged in the regression models except PAVGO even though it shows negative association with IPS found to be excluded from the regression models. The variable VLS shows no significant association with IPS, also excluded from the regression models. Among the Predictor Variables, MGO has the highest correlation (r = .464) with the IPS and hence it was selected to enter first in the analysis. The interpretation and discussion regarding emerged models are as follows.

Table 70 shows that for the derived Model 1, it is clear that MGO alone was analysed as predictor and taken against the Criterion Variable (Y), that yielded a Coefficient of Multiple Correlations (R) of .464 with a Standard Error of the Estimate (SE_R) of 14.956. The Coefficient of Determination (R^2) of Model 1 is .216 and the Adjusted R Square is .214. The R^2 value explained that 21.6% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .216, F(1, 410) = 112.87**, p<.01) as the obtained value exceed the tabled value of F (F(1, 410) = 6.66). In this model, the values of R^2 and R^2 change are equal because this model contains the influence of MGO alone.

While considering the Model 2 derived out of regression, shows whether there exist any significant increases in the amount of variance accounted by the next predictor variable, PAPGO to the IPS. In this model, when the Predictor Variables; MGO and PAPGO are collectively taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .504 with a Standard Error of the Estimate (SE_R) of 14.60. The Coefficient of Determination (R^2) of Model 2 is .254 and the Adjusted R^2 is .250. The R^2

value implied that 25.4% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .254, $F(2,409)$ = 69.60, $p<.01$), since the calculated F-value exceeds the tabled value of F ($F(2,409)$ = 4.62).

The value of R^2 change is .038 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 3.8%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry Subject.

With respect to the Model 3 derived, shows whether there exists significant increase in the amount of variance accounted by the next Predictor Variable, MA to the IPS. In this model, when the Predictor Variables; MGO, PAPGO and MA are collectively taken against the IPS, which yielded a Coefficient of Multiple Correlations (R) of .522 with Standard Error of the Estimate (SE_R) of 14.43. The Multiple Correlation Square (R^2) of Model 3 is .273 and the Adjusted R^2 is .267. The R^2 value implied that 27.3% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 = .273, $F(3, 408)$ = 50.97, $p<.01$) since the calculated F- value exceeds the tabled value of F ($F(3, 408)$ =3.80).

The value of R^2 change is .019 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is

1.9%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and PAPGO for predicting the IPS of Secondary School Students.

The fourth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next Predictor Variable, ALS to the IPS. In this model the Predictor Variables MGO, PAPGO, MA and VLS are collectively taken against the IPS, that yielded a Coefficient of Multiple Correlations (R) of .529 with Standard Error of the Estimate (SE_R) of 14.38. The Multiple Correlation Square (R^2) of Model 4 is .280 and the Adjusted R Square is .273. The R^2 value implied that 28.0% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, MA and ALS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 = .280, F(4, 407) = 39.59, p<.01), since the calculated F-value exceeds the tabled F value (F(4, 407) = 3.34).

The value of R^2 change is .007 indicates that the increase in percentage variance accounted for the Predictor ALS to MGO, PAPGO and MA is 0.7%. This suggests that the predictor ALS is also significantly contributing to the derived model and which comes fourth in the sequential order for predicting the IPS of Male students.

The fifth model derived from the Stepwise Regression Analysis explains the significant increase in the amount of variance accounted by the next predictor variable, KLS to the IPS. In this model, when the Predictor Variables; MGO, PAPGO, MA, ALS and KLS are collectively taken against the IPS, which yielded a Coefficient of Multiple Correlations (R) of .541 with

Standard Error of the Estimate (SE_R) of 14.27. The Coefficient of Determination (R^2) of Model 5 is .293 and the Adjusted R Square is .284. The R^2 value implied that 29.3% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, MA, ALS and KLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 5 is significant (R^2 = .293, $F(5, 406) = 3.60$, $p<.01$) since the calculated F-value exceeds the tabled value of F ($F(5, 406) = 3.04$).

The value of R square change is .013 indicates that the increase in percentage variance accounted for the variable KLS to MGO, PAPGO, MA and ALS is 1.3%. This suggests that the predictor, KLS is also significantly contributing to the derived model and which comes fifth position in the sequential order for predicting the IPS of Male students.

b) ***Coefficient Summary of the Predictor Variables; MGO, PAPGO, MA, ALS and KLS on Integrated Process Skills in Chemistry for Male Sample.***

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised Regression Coefficients (B) were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 71.

Table 71

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, ALS and KLS on Integrated Process Skills in Chemistry for Male Sample

Model		Un Standardized Coefficients		Standardized Coefficients	t
		B	Std. Error	beta	
1	(Constant)	-2.393	6.609		
	MGO	.974	.092	.464	10.620**
2	(Constant)	29.569	8.771		
	MGO	.931	.090	.444	10.336**
	PAPGO	.410	.090	.196	4.575**
3	(Constant)	47.344	10.261		
	MGO	.970	.090	.462	10.793**
	PAPGO	.376	.089	.180	4.208**
	MA	.231	.071	.139	3.240**
4	(Constant)	31.781	12.723		
	MGO	.958	.090	.457	10.679**
	PAPGO	.368	.089	.176	4.131**
	MA	.238	.071	.143	3.347**
	ALS	-.213	.104	-.087	-2.054*
5	(Constant)	38.454	12.868		
	MGO	.957	.089	.456	10.748**
	PAPGO	.332	.089	.159	3.714**
	MA	.226	.071	.136	3.191**
	ALS	-.310	.109	-.126	-2.844**
	KLS	.247	.092	.120	2.688**

Note: **indicates $p<.01$; *indicates $p<.05$

Table 71 shows that for the derived Model 1, the Unstanderdised Regression '*B*' weight of MGO in writing the regression equation is 0.974. The Standard Error of *B* is 0.092. Further the 'β' value presents Standardized

Regression weight for MGO and which is found to be as 0.464. The respective critical ratio for the *B* and beta value is statistically highly significant (t = 10.620, p<.01). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 21.6%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Male Secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variable; MGO for the Model 1 given by IPS= -2.393 + 0.974MGO. This equation suggests that for 0.974 unit increase in the IPS in Chemistry can be significantly predicted for every unit increase in the Predictor MGO measure.

Table 71 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight of this variable in writing the regression equation is 0.931 for MGO and that of PAPGO is 0.410. The value of Standard Error of *B* for MGO is 0.090 and that of PAPGO is 0.090. Further 'β' value presents Standardized Regression weight of MGO is 0.444 and that of PAPGO is 0.196. The critical ratios for the *B* and beta values for MGO (t = 10.33) and PAPGO (t = 4.575) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 21.6% and 3.8% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of IPS in Chemistry of Male Students.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO and PAPGO can be written as IPS = 29.56 + 0.931MGO + 0.410PAPGO. This equation suggests that for 0.931 unit increase in IPS can be significantly predicted for every unit increase in MGO, when the effects of PAPGO is held constant and that for every unit increase in the PAPGO the Integrated Process Skills is increases by 0. 410 units, only when the effect of the variable MGO is nullified.

Table 71 shows that for the Model 3, the Unstanderdised Regression Coefficient (*B*) weight of these variables in writing the regression equation is 0.970 for MGO, 0.376 for PAPGO and that of MA is 0.231. The value of Standard Error of *B* for MGO is 0.090, PAPGO is 0.081 and that of MA is 0.07. Further β value presents Standardized Regression weight for MGO is 0.462, PAPGO is 0.180 and that of MA is 0.139. The critical ratios for the beta values of MGO (t = 10.79), PAPGO (t = 4.20) and MA (t = 3.24) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the IPS in Chemistry is significant and the corresponding percentages are 21.6%, 3.8% and 1.9% respectively. Therefore MGO, PAPAGO and MA are Positive significant predictors of IPS in Chemistry of Male students.

The equation to the regression line for predicting Integrated process skills in chemistry (Y) by means of the Predictor Variables; MGO, PAPGO and MA for Model 3, can be written as IPS = 47.344 + 0.970MGO + 0.376 PAPGO + 0.231MA. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.970 units when the effects of PAPGO and MA is held constant and that for every unit increase in the PAPGO the IPS is increases by 0.376 units, only when the effect of the variables MGO and MA is nullified. Similarly for 0.231 unit increase in Integrated Process Skill can be significantly predicted for every unit increase in MA for this model when the effects of MGO and PAPGO are held constant.

Table 71 gives that for the Model 4, the Unstanderdised Regression Coefficient (*B*) weight of these variables in writing the regression equation is 0.958 for MGO, 0.368 for PAPGO, MA is 0.238 and that of ALS is -0.213. The value of Standard Error of B for MGO is 0.090, PAPGO is 0.089, MA is 0.071 and that of ALS is 0.104. Further β value presents Standardized Regression weight for MGO and which is found to be as for MGO is 0.457, PAPGO is 0.176, MA is 0.143 and that of ALS is -0.087. The respective critical ratios for the beta values for MGO (t = 10.67), PAPGO (t = 4.13), MA (t = 3.34) and ALS (t = 2.05) are statistically highly significant (p<.01). It means that the individual contributions of PAGO, MGO, MA and ALS in predicting the IPS in chemistry is significant and the percentage of individual contributions are 21.6%, 3.8%. 1.9% and 0.7% respectively. Among the predictors the ALS is a negative significant predictor of IPS in Chemistry. Therefore PAGO, MAG, MA and ALS are the significant predictors of IPS in Chemistry of Male Secondary School Students.

For Model 4, the equation to the regression line for predicting IPS (Y) by means of the Predictor Variables; MGO, PAPGO, MA and ALS for Model 4 can be represented as IPS = 31.78 + 0.958MGO + 0.368PAPGO + 0.238MA - 0.213ALS. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.958 units when the effects of PAPGO, MA and ALS are held constant and that for every unit increase in the PAPGO the IPS is increases by 0.368 units, only when the effect of the variable MGO, MA and ALS are nullified. Similarly for every unit increase in the MA the IPS is increased by 0.238 units only when the effects of MGO, PAPGO and ALS are nullified. But for 0.213 unit increase in IPS can be significantly predicted for every unit decrease in the predictor ALS when the effects of MGO, PAPGO and MA are held constant.

Table 71 gives that for the Model 5, the Unstanderdised Regression Coefficient (*B*) weight of these variables in writing the regression equation is 0.957 for MGO, 0.332 for PAPGO, MA is 0.226, ALS is -0.310 and that of KLS is 0.247. The value of Standard Error of *B* for MGO is 0.089, PAPGO is 0.089, MA is 0.071, ALS is 0.109 and that of KLS is 0.092. Further β value presents Standardized Regression weight of MGO is 0.456, PAPGO is 0.159, MA is 0.136, ALS is 0.126 and that of KLS is 0.120. The critical ratios for the beta values for MGO (t = 10.74), PAPGO (t = 3.714), MA (t = 3.191), ALS (t = 2.84) and KLS (t = 2.688) are significant (p<.01). It means that the individual contributions of PAGO, MGO, MA, ALS and KLS in predicting the IPS in Chemistry is significant and the percentage of individual contributions are 21.6%, 3.8%. 1.9%, 0.7% and 1.3% respectively. Therefore PAGO, MAG, MA, ALS and KLS are the significant predictors of IPS in Chemistry of Male Secondary School Students.

For Model 5, the equation to the regression line for predicting IPS (Y) by means of the Predictor Variables; MGO, PAPGO, MA, ALS and KLS can be represented as IPS = 38.54 + 0.957 MGO + 0.332PAPGO + 0.226MA-0.310ALS + 0.247KLS. This equation suggests that for every unit increase in X2 (MGO), the increase in Y is 0.957 units when the effects of X3, X1, X6 and X7 are held constant and that for every unit increase in the X3(PAPGO) IPS is increased by 0.332 units, only when the effect of the variable X2, X1, X6 and X1 are nullified. Similarly for every unit increase in the X1 (MA) the IPS is increased by 0.226 units only when the effects of MGO, PAPGO, ALS and KLS are nullified. Where as in case of ALS; every unit decrease in the X6 (ALS) the IPS is increased by 0.310 units when the effects of MGO, PAPGO, MA and KLS are held constant and for every unit increase in the X7 (KLS) the IPS is increased by 0.247 units when the effects of MGO, PAPGO, MA and ALS are held constant.

In brief, it can be said that, out of seven Predictor Variables, five variables are emerged as the significant predictors and therefore five models are derived out of the stepwise regression analysis. The Predictors; ***MGO, PAPGO, MA, ALS and KLS make significant influence (Individually & Collectively) upon IPS of Male Students*** and the Predictors; VLS and PAVGO are not influencing the IPS in Chemistry of Male Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for Female Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis for Female students. The data of the inter-correlation of Criterion variable with seven Predictor Variables are given in Table 72.

Table 72

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables; MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS for the Female Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.179**	1.000						
MGO	.369**	-.014	1.000					
PAPGO	.160**	.116	.007	1.000				
PAVGO	-.024^{ns}	.002	-.058	-.007	1.000			
VLS	.081*	.203	-.079	.251	-.088	1.000		
ALS	-.087*	-.044	-.009	.006	.020	.150	1.000	
KLS	.092*	.146	.055	.183	-.006	.321	.309	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 72 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA, and are (r=.179, p<.01), MGO, (r=.369, p<.01), PAPGO, (r=.160, p<.01), VLS, (r=.081, p<.05), ALS (r=-.087, p<.05) and KLS (r=.092, p<.05), indicates significant association with IPS. Among the Predictor Variables; ALS show negative association with IPS and all others show positive association with IPS. The Predictor PAVGO (r= .024, p=ns) is not significantly associated with IPS for Female sample.

Hence the correlation matrix implied that the Predictor Variables; MGO, PAPGO, MA, VLS, and KLS shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non- linear) with IPS in Chemistry for the Female Sample.

a) Model Summary of the Predictor Variables; MGO, PAPGO, MA, and VLS on Integrated Process Skills in Chemistry for Female Sample.

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages is represented by for the Female sample are given in the Table 73.

Table 73

Model Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on Integrated Process Skills in Chemistry for the Female Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.369	.136	.134	.134	16.34
2	.412	.170	.167	.034	16.03
3	.434	.188	.184	.018	15.86
4	.452	.204	.199	.016	15.72

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
4. *Predictors:(Constant),MGO, PAPGO, MA, VLS*

Criterion Variable: IPS

Table 73 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first, second, third and fourth models are .369, .412, .434 and .452 respectively. The Coefficient of Determination (R^2) for first, second, third and fourth models are .136, .170, .188 and .204 respectively. The details of interpretations of these coefficients are presented in the following sections.

The significance of the regression model derived for the Predictor Variables; MGO, PAPGO, MA, and VLS to the Criterion Variable are presented by ANOVA Summary Table 74.

Table 74

ANOVA Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on Integrated Process Skills in Chemistry for Female Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	23763.557	1	23763.557	
	Residual	151217.683	566	267.169	88.946**
	Total	174981.239	567		
2	Regression	29693.468	2	14846.734	
	Residual	145287.772	565	257.146	57.736**
	Total	174981.239	567		
3	Regression	32953.783	3	10984.594	
	Residual	142027.457	564	251.822	43.621**
	Total	174981.239	567		
4	Regression	35770.055	4	8942.514	
	Residual	139211.184	563	247.267	36.165**
	Total	174981.239	567		

Note: **indicates p<.01

From Table 73 and Table 74 shows that four models are derived, the Predictor Variables; MGO, PAPGO, MA, VLS, and KLS shows substantial or marked relation with IPS in Chemistry are found to be emerged and others with significant relation (ALS and KLS) are excluded from the regression models. But the predictor; PAVGO (r= -.024, p=ns) shows no significant correlation with IPS is also excluded from the regression model. Among the Predictor Variables, MGO has the highest correlation (r = .369) with the IPS and hence it was selected to enter first in the analysis. The interpretation and discussion regarding emerged models are as follows.

Table 74 shows for the derived Model 1, it is clear that the Predictor Variable; MGO taken against the Criterion Variable (IPS), which yielded a

Coefficient of Multiple Correlations (R) of .369 with Standard Error of the Estimate (SE_R) of 16.34. The Coefficient of Determination (R^2) of Model 1 is .136 and the Adjusted R Square is .134. The R^2 value implied that 13.6% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 = .136, $F(1, 566) = 88.94$, $p<.01$) as the obtained value exceed the tabled value of F ($F(1, 566) = 6.66$). It is therefore concluded that the MGO is identified as the most potential predictor and contributes significantly to the model developed for the Criterion Variable; IPS in Chemistry for Female Secondary School Students.

The Model 2, derived out of regression shows whether there exist any significant increases in the amount of variance accounted by the next Predictor Variable, PAPGO (X3) to the IPS. In this model, MGO and PAPGO are jointly taken against the IPS and that yielded a Coefficient of Multiple Correlations (R) of .412 with a Standard Error of the Estimate (SE_R) of 16.03. The Multiple Correlation Square (R^2) of Model 2 is .170 and the Adjusted R Square is .167. The R^2 value explained that 17.0% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .170, $F(2, 565) = 57.73$, $p<.01$), since the calculated F-value exceeds the tabled value of F ($F(2, 565) = 4.62$).

The value of R square change is .034 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 3.4%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry subject.

The Model 3 derived from the Regression shows the significant increase in the amount of variance accounted by the next Predictor Variable, MA to the IPS. In this model the Predictor Variables; when MGO, PAPGO and MA are jointly taken against the IPS, which yielded a Coefficient of Multiple Correlations (R) of .434 with Standard Error of the Estimate (SE_R) of 15.86. The Multiple Correlation Square (R^2) of Model 3 is .188 and the Adjusted R Square is .184. The R^2 value implied that 18.8% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 =.188, $F(3, 564) = 43.62$, $p<.01$), since the calculated F- value exceeds the tabled value of F ($F(3, 564) = 3.80$).

The value of R^2 change is .018 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is 1.8%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequential order of predictors i.e. after MGO and PAPGO for predicting the IPS of Female high school students.

The fourth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor Variable, VLS to the IPS. In this model, MGO, PAPGO, MA and VLS are jointly taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .452 and the Standard Error of the Estimate is (SE_R) 15.72.

The Multiple Correlation Square (R^2) of Model 4 is .204 and the Adjusted R^2 is .199. The R^2 value implied that 20.4% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, MA and VLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 = .204, $F(4, 567) = 36.165$, $p<.01$), since the calculated F-value exceeds the tabled value of F ($F(4, 567) = 3.34$).

The value of R^2 change is .016 which indicates that the increase in percentage variance accounted for the variable VLS to MGO, PAPGO and MA is 1.6%. This suggests that the predictor VLS is also significantly contributing to the derived model and which comes forth in the sequential order for predicting the IPS of Female students.

b) Coefficient Summary of the Predictor Variables; MGO, PAPGO, MA, and VLS on Integrated Process Skills in Chemistry for Female Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 75.

Table 75

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, MA, and VLS on Integrated Process Skills in Chemistry for Female Sample

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	14.594	5.661		
	MGO	.744	.079	.369	9.431**
2	(Constant)	10.320	7.600		
	MGO	.749	.077	.371	9.679**
	PAPGO	.322	.067	.184	4.802**
3	(Constant)	29.978	9.296		
	MGO	.747	.077	.370	9.749**
	PAPGO	.298	.083	.137	3.598**
	MA	.294	.067	.168	4.401**
4	(Constant)	15.785	10.126		
	MGO	.726	.076	.359	9.529**
	PAPGO	.366	.085	.168	4.324**
	MA	.335	.067	.192	4.977**
	VLS	.269	.080	.134	3.375**

Note: **indicates p<.01

Table 75 shows that for the derived Model 1, the Unstanderdised Regression Coefficient (B) weight of the variable; MGO in writing the regression equation is 0.74 and the Standard Error of B is 0.079. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.369. The critical ratio for the beta value is statistically highly significant (t = 9.43, p<.01). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to IPS is 13.6%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Female Secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variable MGO (X2) for the Model 1 can be written as IPS = 14.594 + 0.74MGO. This equation suggests that for 0.74 unit increase in the IPS in Chemistry can be significantly predicted for every unit increase in MGO score for this model.

Table 75 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight of this variable in writing the regression equation is 0.749 for MGO and that of PAPGO are 0.322. The value of Standard Error of *B* for MGO is 0.077 and that of PAPGO is 0.067. Further β value presents Standardized Regression weight for MGO is 0.371 and that of PAPGO is 0.184. The critical ratios for the B and beta values for MGO (t = 9.679) and PAPGO (t = 4.802) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 13.6% and 3.4% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of IPS in Chemistry for Female students.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO (X2) and PAPGO (X3) can be written as IPS = -10.32 + 0.749 MGO + 0.322PAPGO. This equation suggests that for unit increase in MGO (X2), the increase in IPS is 0.749 units when the effects of PAPGO is held constant and that for unit increase in the PAPGO (X3) the Integrated Process Skills is increases by 0. 322 units, only when the effect of the variable MGO is nullified.

Table 75 shows that for the Model 3, the Unstanderdised Regression Coefficient 'B' weight of these variables in writing the regression equation is 0.747 for MGO, 0.298 for PAPGO and that of MA is 0.294. The value of Standard Error of B for MGO is .077, PAPGO is 0.083 and that of MA is 0.067.The beta value of MGO is 0.370, PAPGO is 0.137 and that of MA is 0.108. The respective critical ratios for the beta values for MGO (t = 9.749), PAPGO (t = 3.58), and MA (t = 4.40) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the IPS in Chemistry is significant and the corresponding percentages are 13.6%, 3.4% and 1.9% respectively. Therefore MGO, PAPAGO and MA are Positive significant predictors of IPS in Chemistry.

The equation to the regression line for predicting Integrated Process Skills in Chemistry (Y) by means of the predictor variables MGO (X3), PAPGO(X4) and MA(X1) for Model 3 can be written as IPS = -29.97 + 0.747MGO + 0.298PAPGO + 0.294MA. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.747 units when the effects of PAPGO and MA is held constant and for every unit increase in the PAPGO the Integrated Process skills is increases by 0.298 units, only when the effect of the variables MGO and MA is nullified. Similarly for every unit increase in the MA the IPS is increased by 0. 294 units when the effects of MGO and PAPGO are held constant.

Table 75 gives that for the Model 4, the Unstanderdised Regression Coefficient of MGO is 0.359, PAPGO is 0.168, MA is 0.192 and that of VLS is 0.134. The 'B' weight of these variables in writing the regression equation is 0.726 for MGO, 0.366 for PAPGO, MA is 0.335 and that of VLS is 0.269. The value of Standard Error of *B* for MGO is 0.076, PAPGO is 0.085, MA is 0.067 and that of VLS is 0.080.The respective critical ratios for the *B* and beta values for MGO (t = 9.52), PAPGO (t = 4.324), MA (t = 4.97) and VLS (t = 3.375) are statistically highly significant (p<.01). It means that the individual contributions of PAGO, MGO, MA and VLS in predicting the Integrated Process Skills in chemistry is significant and the percentage of individual contributions are 13.6%, 3.4%. 1.9% and 1.6% respectively. Therefore PAGO, MAG, MA and VLS are the significant positive predictors of IPS in Chemistry of Female secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO(X2), PAPGO(X3), MA(X1) and VLS(X5) for Model 4, can be represented as IPS = -15.78 + 0.726MGO + 0.366PAPGO + 0.335MA + 0.269VLS. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.726 units when the effects of PAPGO, MA and VLS are held constant and that for unit increase in the PAPGO the IPS is increases by 0.366 units, only when the effect of the variable MGO, MA and VLS are nullified. Similarly for the unit increase in the MA the IPS is increased by 0.335 units only when the effects of MGO, PAPGO and VLS are nullified. Also for unit increase in the predictor VLS the IPS is increased by 0.269 units when the effects of MGO, PAPGO and MA are held constant.

In brief, it can be said that that out of seven Predictor Variables only four variables are emerged as the significant predictors and therefore four models are derived out of the stepwise regression analysis. The Predictors; MGO, PAPGO, MA and VLS ***make significant influence (individually & collectively) upon IPS of Female students*** and the Predictors; PAVGO and

ALS and KLS are not influencing the IPS of Female high school students in the Subject of Chemistry.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Urban Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis for Urban Sample. The data of the inter-correlation of Criterion variable with seven Predictor Variables are given in Table 76.

Table 76

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for the Urban Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.134**	1.000						
MGO	.372**	-.036	1.000					
PAPGO	.136**	.055	.004	1.000				
PAVGO	-.016^{ns}	-.033	-.053	-.014	1.000			
VLS	.144**	.158	-.160	.235	-.085	1.000		
ALS	-.120**	.008	-.008	-.019	.013	.173	1.000	
KLS	.072*	.162	.010	.127	.038	.299	.306	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 76 reveals the Pearson's Product Moment Coefficient Of Correlation (r) between the IPS and the Predictor Variables; MA (r = .134, p<.01), MGO, (r = .372, p<.01), PAPGO (r = .136, p<.01), VLS (r = .144, p<.01), ALS (r = -.120, p<.01) and KLS (r = .072, p<.05) indicates that the predictors MGO, PAPGO, MA, VLS, and KLS having significant positive relation and for ALS, there exist significant negative relation with IPS. But the Predictor; PAVGO (r = -.016, p=ns) shows no significant relation with IPS.

Hence the correlation matrix inferred that the Predictor Variables; MGO, PAPGO, MA, VLS, and KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non- linear) with IPS in Chemistry for the Urban Sample.

a) ***Model Summary of the Predictor Variables; MGO, MA, PAPGO VLS, and ALS on Integrated Process Skills in Chemistry for Urban Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages is represented by for Urban sample are given in the Table 77.

Table 77

Model Summary for Regression of the Predictor Variables; MGO, MA, PAPGO VLS, and ALS on Integrated Process Skills in Chemistry for Urban Sample

Model	R	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.372	.139	.137	.139	17.11
2	.400	.160	.157	.022	16.91
3	.420	.176	.171	.016	16.77
4	.444	.197	.190	.021	16.58
5	.453	.205	.197	.008	16.51
6	.464	.215	.205	.010	16.42

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, MA*
3. *Predictors: (Constant), MGO, MA, PAPGO,*
4. *Predictors:(Constant),MGO, MA, PAPGO, VLS*
5. *Predictors:(Constant),MGO,MA, PAPGO, VLS, ALS*
6. *Predictors:(Constant),MGO, MA, PAPGO, VLS, ALS, KLS*

Criterion Variable: IPS

Table 77 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first, second, third, fourth, fifth and sixth models are .372, .400, .420, .444, .453 and .464 respectively. The Coefficient of Determination (R^2) for first, second, third, fourth, fifth and sixth models are 0.139, 0.160, 0.176, 0.197, 0.205 and 0.215 respectively. The details of interpretations of these coefficients are presented in the following sections.

The significance of the regression model derived for the Predictor Variables; MGO, MA, PAPGO, VLS, ALS, and KLS to the Criterion Variable IPS of Urban students are explained by ANOVA Summary Table 78.

Table 78

ANOVA Summary for Regression of the Predictor Variables; MGO, MA, PAPGO, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for Urban Sample

	Model	Sum of Squares	*df*	Mean Square	*F*
1	Regression	22071.613	1	22071.613	75.313**
	Residual	137154.251	468	293.065	
	Total	159225.864	469		
2	Regression	25538.413	2	12769.206	44.606**
	Residual	133687.451	467	286.269	
	Total	159225.864	469		
3	Regression	28088.512	3	9362.837	33.271**
	Residual	131137.352	466	281.411	
	Total	159225.864	469		
4	Regression	31359.773	4	7839.943	28.511**
	Residual	127866.091	465	274.981	
	Total	159225.864	469		
5	Regression	32670.563	5	6534.113	23.957**
	Residual	126555.301	464	272.748	
	Total	159225.864	469		
6	Regression	34282.399	6	5713.733	21.173**
	Residual	124943.465	463	269.856	
	Total	159225.864	469		

Note: **indicates $p<.01$

From Table 77 and Table 78 shows that six models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with the Criterion Variable. MGO, PAPGO, MA, VLS, ALS and KLS which show substantial or marked relation with IPS in Chemistry are found to be emerged in to the regression models. The only one predictor which is excluded from the regression model is PAVGO. Among the Predictor Variables, MGO has the highest correlation (r= .372) with the IPS and hence it was selected to enter first in the analysis.

Table 77 and 78 shows from the derived Model 1, MGO was analysed as the predictor and taken against the Criterion Variable(Y), yielded a Coefficient of Multiple Correlations (R) of .372 with a Standard Error of the Estimate (SE_R) of 17.11. The Coefficient of Determination (R^2) of Model 1 is .139 and the Adjusted R^2 is .136. The R^2 value translated into 13.9% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model1 is significant (R^2 = .139, $F(1, 468) = 75.33$, $p< .01$), as the obtained value exceed the tabled value of F (F (1, 468) = 6.66). In this model the values of R^2 and R^2 change are equal because this model contains the influence of MGO.

With respect of the Model 2, shows whether there exist any significant increases in the amount of variance accounted by the next predictor variable, MA to the IPS. In this model, when MGO and MA are collectively taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .400 with a Standard Error of the Estimate (SE_R) is 16.91. The Multiple Correlation Square (R^2) of Model 2 is .160 and the Adjusted R^2

is .157. The R^2 value implied that 16.0% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 =.160, $F(2, 467) = 44.60$, $p<.01$), since the calculated F-value exceeds the tabled value of F ($F(2, 467) = 4.62$).

The value of R^2 change is .022 which indicates that the increase in percentage variance accounted for the variable MA to MGO is 2.2%. This suggests that the predictor MA is also significantly contributing to the model 2 along with MGO. In this model the MA emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry subject.

The third model derived from the regression shows the significant increase in the amount of variance accounted by the next Predictor Variable, PAPGO to the IPS. In this model, when MGO, MA and PAPGO are jointly taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .420 and the Standard Error of the Estimate (SE_R) is 16.77. The Multiple Correlation Square (R^2) of model 3 is .176 and the Adjusted R^2 is .171. The R^2 value implied that 17.6% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, MA and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 = .171, $F(3, 466) = 33.27$, $p<.01$), since the calculated F- value exceeds the tabled value of F ($F(3, 466) = 3.80$).

The value of R^2 change is .016 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO and MA is

1.6%. This model suggests that the predictor PAPGO is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and MA for predicting the IPS of high school students in the Urban sample.

The forth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, VLS to the IPS. In this Model, when MGO, MA, PAPGO and VLS are collectively taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .444 with a Standard Error of the Estimate (SE_R) of 16.58. The Coefficient of Determination (R^2) of Model 4 is .197 and the Adjusted R^2 is .190. The R^2 value translated into 19.7% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, MA, PAPGO and VLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 =.197, $F(4, 465)$ = 28.511, $p<.01$), since the calculated F-value exceeds the tabled value of F ($F(4, 465) = 3.34$).

The value of R^2 change is .021 which indicates that the increase in percentage variance accounted for the variable VLS to MGO, MA and PAPGO is 2.1%. This suggests that the predictor VLS is also significantly contributing to the derived model and which comes forth in the sequential order for predicting the IPS of Urban high school students.

The fifth model derived from the Stepwise Regression Analysis shows the significant increase in the amount of variance accounted by the next predictor variable, ALS to the IPS. In this model, when MGO, MA, PAPGO, VLS and ALS are collectively taken against the IPS, yielded a

Coefficient of Multiple Correlations (R) of .453 and the Standard Error of the Estimate (SE_R) is 16.51. The Coefficient of Determination (R^2) of Model 4 is .205 and the Adjusted R^2 is .197. The R^2 value implied that 20.5% of the observed variance in the Integrated Process Skill scores is accounted by the collective contribution of MGO, MA, PAPGO, VLS and ALS. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 = .205, $F(5, 464) = 23.95$, $p<.01$), since the calculated F- value exceeds the tabled value of F ($F(5, 464) = 3.04$).

The value of R^2 change is .008 which indicates that the increase in percentage variance accounted for the variable ALS to MGO, MA PAPGO, and VLS is 0.8%. This suggests that the predictor ALS is also significantly contributing to the derived model and which comes fifth position in the sequential order for predicting the IPS of high school students.

With respect to the sixth model derived from the stepwise regression analysis shows the significant increase in the amount of variance accounted by the next predictor variable, KLS to the IPS. In this model, when the Predictor Variables; MGO, MA, PAPGO, VLS, ALS and KLS are collectively taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .464 with Standard Error of the Estimate (SE_R) is 16.42. The Multiple Correlation Square (R^2) of model 4 is .215 and the Adjusted R^2 is .205. The R^2 value translated into 21.5% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, MA, PAPGO, VLS, ALS and KLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 6 is significant (R^2 =.215, $F(6, 463) = 21.173$, $p<.01$), since the calculated F- value exceeds the tabled value of F ($F(6, 463) = 2.82$).

The value of R^2 change is .010 indicates that the increase in percentage variance accounted for the variable KLS to MGO, MA, PAPGO, VLS and KLS is 1.0%. This suggests that the predictor KLS is also significantly contributing to the derived model and which comes sixth position in the sequential order for predicting the IPS of Secondary School Students.

b) Coefficient Summary of the Predictor Variables; MGO, MA, PAPGO, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for Urban Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 79.

Table 79

Coefficient Summary for Regression of the Predictor Variables; MGO, MA, PAPGO, VLS, ALS, and KLS on Integrated Process Skills in Chemistry for the Urban Sample

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	Beta	
1	(Constant)	11.777	6.414		
	MGO	.779	.090	.372	8.678**
2	(Constant)	9.591	8.825		
	MGO	.790	.089	.378	8.899**
	MA	.272	.078	.148	3.480**
3	(Constant)	29.258	10.920		
	MGO	.788	.088	.377	8.958**
	MA	.259	.077	.141	3.340**
	PAPGO	.280	.093	.127	3.010**
4	(Constant)	9.712	12.192		
	MGO	.739	.088	.353	8.384**
	MA	.298	.077	.162	3.846**
	PAPGO	.357	.095	.161	3.766**
	VLS	.322	.094	.151	3.449**
5	(Constant)	3.311	13.518		
	MGO	.743	.088	.355	8.466**
	MA	.295	.077	.160	3.820**
	PAPGO	.344	.094	.155	3.637**
	VLS	.284	.095	.133	3.000**
	ALS	-.220	.100	-.092	-2.192*
6	(Constant)	-.069	13.517		
	MGO	.731	.087	.350	8.359**
	MA	.270	.077	.147	3.484**
	PAPGO	.326	.094	.147	3.457**
	VLS	.337	.097	.158	3.488**
	ALS	-.291	.104	-.122	-2.798*
	KLS	.236	.097	.111	2.444*

Note: **indicates *p*<.01, *indicates *p*<.05

Table 79 shows that for the derived Model 1, the Unstanderdised Regression Coefficient (*B*) weight of the Variable MGO in writing the regression equation 0.779 and the Standard Error of *B* is 0.090. Further β value presents Standardized Regression weight for MGO 0.372. The critical ratio for **B** and the beta value is statistically highly significant (t = 8.678, p<.01). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to BPS is 13.9%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Urban Secondary School Students.

For Model 1, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the predictor variables MGO (X2). Hence the regression equation for the Model 1 in general term can be written as IPS = 11.77 + 0.779MGO This equation suggests that for 0.779 unit increase in the IPS can be significantly predicted for every unit increase in the Predictor MGO (X2) for this model.

Table 79 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight of this variable in writing the regression equation is 0. 790 for MGO and that of MA are 0.272. The value of Standard Error of *B* for MGO is 0.089 and that of MA is 0.078. Further β value presents Standardized Regression weight of MGO is 0.378 and that of MA is 0.148. The critical ratio for the *B* and the beta values for MGO (t = 8.89) and MA (t = 3.48) are statistically significant (p<.01). It means that the individual contributions of MGO and MA in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 13.9% and 2.2% respectively. Hence the predictors MGO and MA are identified as the significant positive predictors of IPS in Chemistry.

The equation to the regression line for predicting Integrated Process Skills in Chemistry (Y) by means of the Predictor Variables MGO (X2) and MA (X2) can be written as IPS = 9.591 + 0.790MGO + 0.272MA. This equation suggests that for every unit increase in the predictor MGO (X2), the increase in IPS is 0.790 units when the effects of MA is held constant and that for every unit increase in the MA (X1), the Integrated Process Skills is increases by 0.272 units, only when the effect of the variable MGO is nullified.

Table 79 shows that for the Model 3, the Unstanderdised Beta Coefficient (*B*) weight of these variables in writing the regression equation is 0.788 for MGO, 0.259 for MA and that of PAPGO is 0.280. The critical ratios for the beta values for MGO (t = 8.98), MA (t = 3.340) and PAPGO (t = 3.010) are statistically highly significant (p<.01). It means that the individual contributions of MGO, MA and PAPGO in predicting the IPS in Chemistry is significant and the corresponding percentages are 13.9%, 2.2% and 1.6% respectively. The value of Standard Error of *B* for MGO is 0.088, MA is 0.077 and that of PAPGO is 0.093. Further β value presents standardized regression weight of MGO is 0.37, MA is 0.141and that of PAPGO is 0.127.Therefore MGO, MA and PAPAGO are Positive significant predictors of IPS in Chemistry for Urban Students.

The equation to the regression line for predicting Integrated process skills in chemistry (Y) by means of the Predictor Variables MGO (X2), MA(X1) and PAPGO(X3) can be written as IPS = 29.25 + 0.788MGO + 0.259MA + 0.280PAPGO. This equation suggests that for every unit increase in MGO, the increase in IPS is 0.788 units when the effects of MA and

PAPGO is held constant and that for every unit increase in the MA the Integrated Process skills is increases by 0.259 units, only when the effect of the variables MGO and PAPGO is nullified. Similarly for every unit increase in the PAPGO the Integrated Process Skill is increased by 0. 280 units when the effects of MGO and MA are held constant.

Table 79 shows that for the Model 4, the Unstanderdised Beta Coefficient (*B*) weight of these variables in writing the regression equation is 0.739 for MGO, 0.298 for MA, PAPGO is 0.357 and that of VLS is 0.322. The critical ratios for the beta values for MGO (t = 8.384), MA (t = 3.846), PAPGO (t = 3.766) and VLS (t = 3.449) are statistically highly significant (p<.01). It means that the individual contributions of MGO, MA PAGO and VLS in predicting the IPS in chemistry is significant and the percentage of individual contributions are 13.9%, 2.2%. 1.6% and 2.1% respectively. The value of Standard Error of *B* for MGO is 0.088, MA is 0.077, PAPGO is 0.095 and that of VLS is 0.094. Further β value presents Standardized Regression weight of MGO is 0.353, MA is 0.162, PAPGO is 0.161 and that of VLS is 0.151.Therefore MGO, MA, PAPGO and VLS are the significant predictors of IPS in Chemistry of Secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the predictor variables MGO(X2), MA(X1), PAPGO(X3), and VLS(X5) can be represented as IPS = 9.712 + 0.739 MGO + 0.298 MA + 0.357PAPGO + 0.322VLS. This equation suggests that for unit increase in MGO, the increase in IPS is 0.739 units when the effects of MA, PAPGO, and VLS are held constant and that for unit increase in the MA the Integrated

Process Skills is increases by 0.298 units, only when the effect of the variable MGO, PAPGO and VLS are nullified. Similarly for the unit increase in the PAPGO the Integrated Process Skill is increased by 0.357 units only when the effects of MGO, MA and VLS are nullified. Also, for unit increase in the predictor VLS the IPS is increased by 0.322 units when the effects of MGO, MA and PAPGO are held constant.

Table 79 gives that for the Model 5, the Unstanderdised Beta Coefficient (*B*) of variables in writing the regression equation is 0.743 for MGO, 0.295 for MA, PAPGO is 0.344, VLS is 0.284 and that of ALS is -0.220. The critical ratio for the beta values for MGO (t = 8.46), MA (t = 3.82), PAPGO (t = 3.637), VLS (t = 3.00) and ALS (t = -2.192) highly significant (p<.01 & p<.05). It means that the individual contributions of MGO, MA, PAGO, VLS and ALS in predicting the IPS in chemistry is significant and the percentage of individual contributions are 13.9%, 2.2%. 1.6%, 2.1% and 0.8% respectively. The value of Standard Error of B for MGO is 0.088, MA is 0.077, PAPGO is 0.074, VLS is 0.075 and that of ALS is 0.100. Further β Value presents standardized regression weight of MGO is 0.355, MA is 0.160, PAPGO is 0.155, VLS is -0.133 and that of ALS is -0.092. Therefore MGO, MA, PAGO, VLS and ALS are the significant predictors IPS in Chemistry of Urban Secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO(X2), MA(X1), PAPGO(X3), VLS(X5) and ALS (X6) can be represented as IPS = 3.311 + 0.743MGO + 0.295MA + 0.344PAPGO + 0.284VLS - 0.220ALS. This equation suggests that for every unit increase in X2 (MGO), the increase in Y is 0.743 units when the effects of MA, PAPGO, VLS and ALS are held constant and that for every unit increase in the X1 (MA) the IPS is increases by 0.295 units, only when the effect of the variable X2, X3, X5 and X6 are nullified. Similarly for every unit increase in the X3 (PAPGO) the IPS is increased by 0.344 units only when the effects of MGO, MA, VLS and ALS are nullified. in case of VLS the every unit increase in the X2 (VLS) the Integrated Process Skill is increased by 0.284 units when the effects of MGO, PAPGO, MA and ALS are held constant, but for unit decrease in the X3(ALS) the IPS is increased by 0.220 units when the effects of MGO, PAPGO, MA and VLS are held constant.

Table 79 gives that for the Model 6, the Unstanderdised Beta Coefficient (*B*) weight of these variables in writing the regression equation is .731 for MGO, 0.270 for MA, PAPGO is 0.326, VLS is 0.337, ALS is -0.291and that of KLS is 0.236. The critical ratios for the beta values for MGO (t = 8.359), MA (t = 3.484), PAPGO (t = 3.457), VLS (t = 3.488), ALS (t = 2.798) and KLS (t = 2.44) are significant (p<.01 & p<.05). It means that the individual contributions of MGO, MA, PAGO, VLS, ALS and KLS in predicting the IPS in Chemistry is significant and the percentage of individual contributions are 13.9%, 2.2%. 1.6%, 2.1%, 0.8% and 1.0% respectively. The value of Standard Error of *B* for MGO is 0.087, MA is 0.077, PAPGO is 0.094, VLS is 0.097, ALS is 0.104 and that of KLS is 0.097. Further β value presents Standardized Regression weight of MGO is 0.350, MA is 0.147, PAPGO is 0.147, VLS is -0.158, ALS is -0.122 and that of KLS is 0.111. Therefore MGO, MA, PAGO, VLS, ALS and KLS are the significant predictors of IPS in Chemistry of Secondary School Students.

The equation to the regression line for predicting Integrated Process Skills In Chemistry (Y) by means of the Predictor Variables; MGO(X2), MA(X1), PAPGO(X3), VLS(X5), ALS (X6) and KLS (X7) can be represented as IPS = 0.69 + 0.731MGO + 0.270MA + 0.326PAPGO + 0.337VLS - 0.291ALS + 0.236KLS. This equation suggests that for every unit increase in X2 (MGO), the increase in IPS is 0.731 units when the effects of X1, X3, X5, X6 and X7 are held constant and that for every unit increase in the X1(MA) the IPS is increases by 0.272 units, only when the effect of the variable X2, X3, X5, X6 and X7 are nullified. For the unit increase in the X3 (PAPGO) the IPS is increased by 0.326 units only when the effects of MGO, MA, VLS, ALS and KLS are nullified. Similarly for VLS; every unit increase in the X2 (VLS) the Integrated Process Skill is increased by 0.337 units when the effects of MGO, MA, PAPGO, ALS and KLS are held constant. Where as in case of ALS unit decrease in the X3 (ALS) the Integrated Process Skill is increased by 0.291 units when the effects of MGO, MA, PAPGO, VLS and KLS are held constant. For KLS; the every unit increase in the KLS (X7) the IPS is increased by 0.236 units only when the effects of MGO, PAPGO, MA, VLS and ALS are nullified.

In brief, it can be summarised as that that out of seven Predictor Variables; six variables are emerged as the significant predictors and therefore six models are derived out of the stepwise regression analysis. Findings revealed that the Predictor Variables; ***MGO, MA, PAPGO, VLS, and KLS make positive and significant influence (individually & collectively) whereas the Predictor; ALS is negatively influencing IPS of Urban Students.*** But the predictor PAVGO is not influencing the IPS of Urban Secondary School Students in the Subject of Chemistry.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Rural Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis for the Rural sample. The data of the inter-correlation of Criterion Variable with seven Predictor Variables are given in Table 80.

Table 80

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for the Rural Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS(Y)	1.000							
MA(X1)	.161**	1.000						
MGO(2)	.443**	-.081	1.000					
PAPGO(X3)	.261**	.168	.096	1.000				
PAVGO(X4)	-.090*	.044	-.078	-.033	1.000			
VLS(X5)	.056^{ns}	.187	.003	.269	-.006	1.000		
ALS(X6)	-.079*	-.023	-.059	-.009	.061	.175	1.000	
KLS(X7)	.130**	.089	.053	.197	-.020	.322	.324	1.000

Note: **indicates p<.01, *indicates p<.05; ns. indicates not significant

Table 80 reveals The Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA (r = .161, p<.01), MGO (r= .443, p<.01), PAPGO (r = .261, p<.01), PAVGO (r= -.090, p<.05), VLS (r =.056, p=ns), ALS (r = -.079, p<.05) and KLS (r = .130, p<.01). The computed r value implied that there exists significant positive relation between the variables MGO, MA, PAPGO, KLS with IPS. Among the Predictor Variables; PAVGO and ALS show negative association with IPS and VLS doesn't shows significant relation with IPS for Rural sample.

Hence the correlation matrix revealed that the Predictor Variables MGO, PAPGO, MA, KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS and PAVGO shows significant negative relation (non-linear) with IPS in Chemistry for the Rural Sample.

a) ***Model Summary of the Predictor Variables; MGO, PAPGO, and MA on Integrated Process Skills in Chemistry for Rural Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (*R*), the Multiple Coefficient of Determination (R^2) and changes in the coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages for Rural sample are given in the Table 81.

Table 81

Model Summary for Regression of the Predictor Variables; MGO, PAPGO, and MA *on Integrated Process Skills in Chemistry for Rural Sample*

Model	*R*	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.443	.196	.195	.196	14.47
2	.494	.244	.241	.048	14.05
3	.520	.270	.266	.026	13.82

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, MA*
   Criterion Variable: IPS

Table 81 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (*R*) for first, second, and third models are .443, .494, and .520

respectively. The Coefficient of Determination (R^2) for first, second, and third models are .196, .244, and .270 respectively. The details of interpretations of these coefficients are presented in the following section.

The significance of the regression model derived the Predictor Variables; MGO, PAPGO, and MA to the Criterion Variable; IPS is explained by ANOVA Summary Table 82.

Table 82

ANOVA Summary for Regression of the Predictor Variables; MGO, PAPGO, and MA on Integrated Process Skills in Chemistry for the Rural Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	26001.648	1	26001.648	
	Residual	106501.217	508	209.648	124.025**
	Total	132502.865	509		
2	Regression	32373.740	2	16186.870	
	Residual	100129.125	507	197.493	81.962**
	Total	132502.865	509		
3	Regression	35811.884	3	11937.295	
	Residual	96690.981	506	191.089	62.470**
	Total	132502.865	509		

Note: **indicates $p<.01$

From Table 81 and Table 82 shows that three models are derived, among Predictor Variables; MGO, PAPGO, MA, PAVGO, ALS and KLS shows substantial or marked relation with IPS in Chemistry, the Predictor Variables; MGO, PAGO and MA is found to be entered in to the significant regression models and the predictors viz; PAVGO, ALS and KLS with significant relation is found to be excluded from the regression models. The predictors; VLS (r = .056, p=ns) shows no significant correlation with IPS is also excluded from the regression models. Among the Predictor Variables, MGO has the highest correlation (*r*= .443) with the IPS and hence it was selected to enter first in the analysis.

With respect to the derived Regression Model 1, when MGO taken against the Criterion Variable (Y), which yielded a Coefficient of Multiple Correlations (*R*) of .443 with a Standard Error of the Estimate (SE_R) of 14.47. The Coefficient of Determination (R^2) of Model 1 is .196 and the Adjusted R^2 is 0.195. The R^2 value implied that 19.6% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding *F* value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2=.196, $F(1, 508)$= 124.02, p<.01), as the obtained value exceed the tabled value of *F* (F (1, 508) = 6.66).

While considering the Model 2, shows whether there exist any significant increases in the amount of variance accounted by the next Predictor Variable, PAPGO to the IPS. In this model, the Predictor Variables; MGO and PAPGO are jointly taken against the IPS, that yielded a Coefficient of Multiple Correlations (*R*) of .494 with a Standard Error of the Estimate (SE_R) of 14.05.The Coefficient of Determination (R^2) of Model 2 is .244 and the Adjusted R^2 is .241. The R^2 value implied that 24.4% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and PAPGO. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2=.241, $F(2, 507)$=81.96, p<.01), since the calculated *F*-value exceeds the tabled value of *F* ($F(2, 507)$ = 4.62).

The value of R^2 change is .048 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 4.8%. This suggests that the predictor PAPGO is also significantly contributing to the

Model 2 along with MGO. In this model, the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry Subject.

With respect to the Model 3 derived from the regression shows the significant increase in the amount of variance accounted by the next Predictor Variable, MA to the IPS. In this model, the Predictor Variables; MGO, PAPGO, MA are jointly taken against the IPS, that yielded a Coefficient of Multiple Correlations (R) of .520 with a Standard Error of the Estimate (SE_R) of 13.82. The Multiple Correlation Square (R^2) of Model 3 is .270 and the Adjusted R^2 is .266. The R^2 value translated into 27.0% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 3 is significant (R^2 =.270, $F(3, 506) = 62.47$, $p<.01$), since the calculated F- value exceeds the tabled value of F ($F(3, 505) = 3.80$).

The value of R^2 change is .026 which indicates that the increase in percentage variance accounted for the variable MA to MGO and PAPGO is 2.6%. This model suggests that the predictor MA is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and PAPGO for predicting the IPS of Rural high school students.

b) Coefficient Summary of the Predictor Variables; MGO, PAPGO, and MA on Integrated Process Skills in Chemistry for the Rural Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (B) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 83.

Table 83

Coefficient Summary for Regression of the *Predictor Variables; MGO, PAPGO, and MA on the Criterion Variable; Integrated Process Skills in Chemistry for the Rural Sample*

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	4.165	5.762		
	MGO	.888	.080	.443	11.137**
2	(Constant)	26.034	7.716		
	MGO	.846	.078	.422	10.875**
	PAPGO	.453	.080	.220	5.680**
3	(Constant)	43.924	8.683		
	MGO	.878	.077	.438	11.423**
	PAPGO	.262	.062	.164	4.242**
	MA	.393	.080	.191	4.932**

Note: **indicates $p<.01$

Table 83 shows that for the derived Model 1, the Unstanderdised Regression Coefficient (*B*) of MGO is 0.88 and the Standard Error of *B* is 0.080. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.443. The critical ratio for the *B* and the beta value of MGO is statistically highly significant (t = 11.13, $p<.01$). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to IPS is 19.6%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Rural Secondary School Students.

For Model 1, the equation to the regression line for Predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO (X2) can be written as IPS = 4.165 + 0.88MGO. This equation suggests that for 0.88 unit increase in the IPS can be significantly predicted for every unit increase in the Predictor MGO (X2) for this model.

Table 83 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) weight is 0. 846 for MGO and that of PAPGO is 0.453. The value of Standard Error of *B* for MGO is 0.078 and that of PAPGO is 0.080. Further β value presents Standardized Regression weight of MGO is 0.422 and that of PAPGO is 0.220. The critical ratio for the *B* and the beta values of MGO (t = 10.87) and PAPGO (t = 5.68) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and PAPGO are 19.6% and 4.8% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of IPS in Chemistry for Rural students.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO (X2) and PAPGO (X3) can be written as IPS = 26.034 + 0.846MGO + 0.453PAPGO. This equation suggests that for every unit increase in MGO (X2), the increase in IPS is 0.846 units when the effects of PAPGO is held constant and that for every unit increase in the PAPGO (X3) the IPS is increases by 0.453 units, only when the effect of the variable MGO is nullified.

Table 83 shows that for the Model 3, the Unstanderdised Regression Coefficient (*B*) is 0.878 for MGO, 0.262 for PAPGO and that of MA is 0.393.

The value of Standard Error of *B* for MGO is 0.077, PAPGO is 0.062 and that of MA is 0.080. Further β value presents Standardized Regression weight of MGO is 0.438, PAPGO is 0.164 and that of MA is 0.191. The critical ratio for the beta values of MGO (t = 11.42), PAPGO (t = 4.24) and MA (t = 4.932) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and MA in predicting the IPS in Chemistry is significant and the corresponding percentages are 19.6%, 4.8% and 2.6% respectively. Therefore MGO, PAPAGO and MA are Positive significant predictors of IPS in Chemistry.

For Model 3, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables MGO (X3), PAPGO(X4) and MA(X1) can be written as IPS = 43.92 + 0.878MGO + 0.292PAPGO + 0.393MA. This equation suggests that for unit increase in MGO, the increase in IPS is 0.878 units when the effects of PAPGO and MA is held constant and that for unit increase in the PAPGO the IPS is increases by 0.292 units, only when the effect of the variables MGO and MA is nullified. Similarly for unit increase in the MA the IPS is increased by 0.393 units when the effects of MGO and PAPGO are held constant.

In brief, it can be said that that out of seven Predictor Variables only three variables are emerged as the significant predictors and therefore three models are derived out of the stepwise regression analysis. The Predictors; ***MGO, PAPGO and MA make significant influence (individually & collectively) upon IPS of Rural students*** and the Predictors; PAVGO, VLS, ALS and KLS are not influencing IPS in Chemistry of the Rural Secondary School Students.

Relative Efficiency of the Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Government Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis with selected Predictor Variables and Integrated Process Skills in Chemistry (IPS) as the Criterion Variable. The data of the inter-correlation of Criterion variable with seven Predictor Variables are presented in Table 84.

Table 84

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for the Government Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.203**	1.000						
MGO	.404**	-.053	1.000					
PAPGO	.124**	.061	.095	1.000				
PAVGO	-.041^{ns}	.049	-.083	-.121	1.000			
VLS	.046^{ns}	.159	-.009	.276	-.089	1.000		
ALS	-.078*	.058	-.067	.031	.041	.270	1.000	
KLS	.115**	.171	.064	.176	-.040	.352	.325	1.000

Note: **indicates *p*<.01, *indicates *p*<.05; ns. indicates not significant

Table 84 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA (r = .203, p<.01), MGO, (r =.404, p<.01), PAPGO (r =.124, p<.01), ALS (r = -.078, p<.05), and KLS (r =.115, p<.01) indicates significant association of these variables with IPS. Among the Predictor Variables, ALS show significant negative relation with IPS and all others show positive relation with IPS. The predictors; PAVGO (r =-.041, p=ns) and VLS (r =.046, p=ns) doesn't show significant relation with IPS for Government sample.

Hence the correlation matrix revealed that the Predictor Variables; MGO, PAPGO, MA, KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non-linear) with IPS in Chemistry for the Government Sample.

a) ***Model Summary of the Predictor Variables; MGO and MA on Integrated Process Skills in Chemistry for the Government Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages is represented by for Government sample are given in the Table 85.

Table 85

Model Summary for Regression of the Predictor Variables; MGO and MA *on Integrated Process Skills in Chemistry for Government Sample*

Model	R	R^2	Adjusted R^2	R^2Change	Standard Error of the Estimate
1	.404	0.163	0.161	0.163	15.94
2	.462	0.213	0.210	0.051	15.47

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, MA*
   Criterion Variable: IPS

Table 85 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (R) for first and second models are .404 and .462 respectively. The Coefficient of Determination (R^2) for first and second models are.163

and .213 respectively. The details of interpretation of these coefficients are presented in the following section.

The significance of the regression model derived for the predictors; MGO and MA to the Criterion Variable; IPS is explained by ANOVA Summary Table 86.

Table 86

Result of ANOVA between the Predictor Variable; MGO and MA on Integrated Process Skills in Chemistry for the Government Sample

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	19734.936	1	19734.936	
	Residual	101388.162	399	254.106	77.664**
	Total	121123.097	400		
2	Regression	25854.790	2	12927.395	
	Residual	95268.307	398	239.368	54.006**
	Total	121123.097	400		

Note: **indicates $p<.01$

From Table 85 and Table 86 shows that two models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with the Criterion Variable; IPS in Chemistry of Government Students. Among the predictors, MGO and MA is found to be entered in to the regression models and others (PAPGO, ALS, and KLS) are found to be excluded from the regression models eventhough they shows significant relation with IPS because of almost all of their shared variability with IPS overlaps with that of other predictors entered in the model being tested. The predictors; PAVGO and VLS heving no relations with IPS were found to be removed from the regression models. Among the Predictor Variables, MGO has the highest correlation (r = .404) with the criterion variable (IPS) and hence it was selected to enter first in the analysis. The interpretation and discussion regarding emerged models are as follows.

With respect to the derived Model 1, it is clear that the Predictor; MGO taken against the IPS, yielded a Coefficient of Multiple Correlations (*R*) of .404 with a Standard Error of the Estimate (SE_R) of 15.94. The Coefficient of Determination (R^2) of Model 1 is .163 and the Adjusted R^2 is 0.161. The R^2 value implied that 16.3% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding *F* value obtained by the ANOVA method for the given R^2 in the model 1 is significant (R^2 =.163, $F(1, 399)$ = 77.66, $p<.01$), as the obtained value exceed the tabled value of *F* ($F(1, 399) = 6.76$). In this model the values of R^2 and R^2 Change are equal because this model contains the influence of MGO.

The Model 2 derived out of regression shows, whether there exist any significant increases in the amount of variance accounted by the next predictor variable, MA to IPS. In this model, when MGO and MA are jointly taken against the IPS, that yielded a Coefficient of Multiple Correlations (*R*) of .462 with a Standard Error of the Estimate (SE_R) of 15.47. The Coefficient of Determination (R^2) of Model 2 is .213 and the Adjusted R^2 is .210. The R^2 value revealed that 21.3% of the observed variance in the IPS scores is accounted by the collective contribution of MGO and MA. The value of *F* obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .213, $F(2, 398)$ = 54.00, $p<.01$), since the calculated *F*- value exceeds the tabled value of *F* ($F(2, 398) = 6.71$).

The value of R^2 change is .051 which indicates that the increase in percentage variance accounted for the variable MA to MGO is 5.1%. This suggests that the predictor MA is also significantly contributing to the Model 2 along with MGO. In this model the MA emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry Subject.

b) ***Coefficient Summary of the Predictor Variables; MGO and MA on Integrated Process Skills in Chemistry for Government Sample.***

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 87.

Table 87

Coefficient Summary for Regression of the *Predictor Variables;* MGO and MA *on Integrated Process Skills in Chemistry for Government Sample*

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	Beta	
1	(Constant)	21.598	5.275		
	MGO	.648	.073	.404	8.813**
2	(Constant)	9.514	8.005		
	MGO	.667	.071	.416	9.334**
	MA	.389	.077	.225	5.056**

Note: **indicates $p<.01$

Table 87 shows that for the derived Model 1, the Unstanderdised Regression Coefficient (*B*) weight of this variable in writing the regression equation 0.648 and the Standard Error of B is 0.073. The critical ratio for *B* and beta value of MGO is statistically highly significant (t = 8.813, $p<.01$). Further β value presents standardized regression weight for MGO and which is found to be as 0.404. It means that the Individual Contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to IPS is 16.3%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Secondary School Students.

For Model1, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO (X2) can be written as IPS=8.813 + 0.648MGO. This equation suggests that for 0.648 unit increase the IPS in Chemistry of Government students can be significantly predicted for every unit increase in the Predictor MGO (X2) for this derived model.

Table 87 shows that for the Model 2, the Unstanderdised Regression Coefficient (B) weights of variable in writing the regression equation is 0. 667 for MGO and that of MA are 0.389. The value of Standard Error of B for MGO is 0.071 and that of MA is 0.077. Further β value presents Standardized Regression weight of MGO is 0.416 and that of MA is 0.225. The critical ratios for the B and the beta values of MGO (t = 9.334) and MA (t = 5.056) are statistically significant (p<.01). It means that the individual contributions of MGO and MA in predicting IPS in Chemistry are highly significant and the percentage of individual contributions of MGO and MA are 16.3% and 5.1% respectively. Hence the predictors MGO and MA are identified as the significant positive predictors of IPS in Chemistry for Aided Students.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the Predictor Variables; MGO (X2) and MA (X2) can be written as IPS= 9.514 + 0.667MGO + 0.389MA. This equation suggests that for every unit increase in MGO (X2), the increase in IPS is 0.667 units when the effects of MA is held constant and that for every unit increase in the

MA (X1) the IPS is increases by 0. 389 units, only when the effect of the variable MGO is nullified.

In brief, it can be said that that out of seven Predictor Variables only two variables are emerged as the significant predictors and therefore two models are derived out of the stepwise regression analysis. The Predictors; ***MGO and MA make significant influence (individually & collectively) upon IPS for Gevernment students*** and the Predictors; PAPGO, PAVGO, VLS, ALS and KLS are not influencing the IPS in Chemistry of Government Secondary School Students.

Relative Efficiency of Predictor Variables; MA, MGO, PAPGO, PAVGO, VLS, ALS, and KLS in Predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Aided Sample.

In this part of the analysis the investigator has employed Multiple Regression Analysis for Aided Sample. The data of the inter-correlation of Criterion variable with seven Predictor Variables are given in Table 88.

Table 88

Inter-correlation (Pearson's r) Matrix of the Criterion Variable (IPS) and the Predictor Variables (MA, MGO, PAPGO, PAVG, VLS, ALS, & KLS) for the Aided Sample

Variables	IPS	MA	MGO	PAPGO	PAVGO	VLS	ALS	KLS
IPS	1.000							
MA	.108**	1.000						
MGO	.443**	-.065	1.000					
PAPGO	.245**	.146	-.009	1.000				
PAVGO	-.058^{ns}	-.027	-.045	.052	1.000			
VLS	.048^{ns}	.187	-.176	.239	-.015	1.000		
ALS	-.116**	-.051	.003	-.045	.032	.114	1.000	
KLS	.085*	.086	-.017	.151	.051	.284	.309	1.000

Note: **indicates *p*<.01, *indicates *p*<.05; NS. indicates not significant

Table 88 reveals the Pearson's Product Moment Coefficient of Correlation (r) between the IPS and the Predictor Variables; MA (r = .104, p<.01), MGO (r = .443, p<.01), PAPGO (r = .245, p<.01), ALS (r = -.116, p<.01), and KLS (r = .085, p<.05) indicates significant association with IPS except for ALS; which shows negative relation with IPS and all others show positive relation with IPS. But the predictor; PAVGO (r = -.016, p=ns) and VLS (r =.048, p=ns) shows no significant relation with IPS for Aided Students.

Hence the correlation matrix implied that the Predictor Variables MGO, PAPGO, MA, KLS which shows substantial or marked linear relation with Integrated Process Skills in Chemistry; whereas the Predictor ALS shows significant negative relation (non- linear) with IPS in Chemistry for the Aided Sample.

a) ***Model Summary of the Predictor Variables; MGO, PAPGO, ALS, MA, KLS on Integrated Process Skills in Chemistry for Aided Sample.***

The model summary of the analysis with Multiple Correlation Coefficient (R), the Multiple Coefficient of Determination (R^2) and changes in the Coefficient of Multiple Determination (R^2 Change) with addition of predictors in successive stages is represented by for Aided sample are given in the Table 89.

Table 89

Model Summary for Regression of the Predictor Variables; MGO, PAPGO, ALS, MA, and KLS on Integrated Process Skills in Chemistry for the Aided Sample

Model	*R*	R^2	Adjusted R^2	R^2 Change	Standard Error of the Estimate
1	.443	.196	.195	.196	15.421
2	.508	.258	.255	.062	14.832
3	.519	.269	.265	.011	14.730
4	.528	.278	.273	.009	14.651
5	.535	.286	.280	.007	14.593

1. *Predictors: (Constant), MGO*
2. *Predictors: (Constant), MGO, PAPGO*
3. *Predictors: (Constant), MGO, PAPGO, ALS*
4. *Predictors:(Constant),MGO,PAPGO, ALS, MA*
5. *Predictors:(Constant),MGO, PAPGO, ALS, MA, KLS*

Criterion Variable: IPS

Table 89 shows the values for the Regression Coefficients that describes the overall regression equation. The Multiple Correlation Coefficient (*R*) for first, second, third, fourth and fifth models are .443, .508, .519, .528 and .535 respectively. The Coefficient of Determination (R^2) for first, second, third forth, and fifth models are 0.196, 0.258, 0.269, 0.278 and 0.286 respectively. The details of interpretations are presented in the following section.

The significance of the regression model derived for the significant predictors; MGO, PAPGO, ALS, MA, and KLS to the Criterion Variable; IPS for Aided students is explained by ANOVA Summary Table 90.

Table 90

ANOVA Summary for the Regression of the *Predictor Variables;* MGO, PAPGO, ALS, MA, and KLS *on Integrated Process Skills in Chemistry for the Aided Sample*

Model		Sum of Squares	*df*	Mean Square	*F*
1	Regression	33463.351	1	33463.351	140.582**
	Residual	137346.186	577	238.035	
	Total	170809.537	578		
2	Regression	44013.074	2	22006.537	99.969**
	Residual	126796.463	576	220.133	
	Total	170809.537	578		
3	Regression	45931.320	3	15310.440	70.497**
	Residual	124878.217	575	217.180	
	Total	170809.537	578		
4	Regression	47539.535	4	11884.884	55.341**
	Residual	123270.002	574	214.756	
	Total	170809.537	578		
5	Regression	48806.457	5	9761.291	45.845**
	Residual	122003.081	573	212.920	
	Total	170809.537	578		

Note: **indicates p<.01, *indicates p<.05; NS. Indicates Not Significant

From Table 89 and Table 90 shows that five models are derived, which exhibit the relative contribution of Predictor Variables (individual and combined) with the Criterion Variable. Hence the Predictor Variables; MGO, PAPGO, MA, ALS and KLS shows substantial or marked relation with IPS in Chemistry are found to be emerged in the significant regression models. But the predictor; PAVGO and VLS show no significant relation with IPS and is found to excluded from the regression models. These were eliminated because almost all of their shared variability with IPS overlaps with that of other predictors entered in the model being tested. Among the Predictor Variables, MGO has the highest correlation (r= 0.443) with the IPS and hence it was selected to enter first in the analysis. The interpretation and discussion regarding emerged models are as follows.

From the derived Regression Model 1, it is clear that the Predictor Variable; MGO taken against the IPS, yielded a Coefficient of Multiple Correlations (R) of .443 with a Standard Error of the Estimate (SE_R) of 15.42. The Multiple Correlation Square (R^2) of Model 1 is .196 and the Adjusted R^2 is .195. The R^2 value implied that 19.6% of the observed variance in the IPS scores is accounted by the MGO because this model presents the sole contribution MGO. The corresponding F value obtained by the ANOVA method for the given R^2 in the Model 1 is significant (R^2 =.443, $F(1, 577)$ =140.58, $p<.01$), as the obtained value exceed the tabled value of F ($F(1, 577)$ = 6.66).Therefore the values of R square and R square change are equal for this model and MGO contributes significantly to the model developed for the Criterion Variable; IPS in Chemistry for Aided sample.

The Model 2, derived out of regression shows, whether there exist any significant increases in the amount of variance accounted by the next predictor, PAPGO to the Criterion Variable; IPS. In this model, the Predictors; MGO and PAPGO are collectively taken against the Criterion Variable (IPS), yielded a Coefficient of Multiple Correlations (R) of .508 with a Standard Error of the Estimate (SE_R) of 14.83. The Coefficient of Determination (R^2) of Model 2 is .258 and the Adjusted R^2 is .255. The R^2 value implied that 25.8% of the observed variance in the IPS scores is explained by the collective contribution of MGO and PAPGO. The value of F obtained by the ANOVA method for the given R^2 in the Model 2 is significant (R^2 = .258, F (2, 576) = 99.96, $p<.01$) since the calculated F- value exceeds the tabled value of F (F (2, 567) = 4.62).

The value of R^2 change is .062 which indicates that the increase in percentage variance accounted for the variable PAPGO to MGO is 6.2%. This suggests that the predictor PAPGO is also significantly contributing to the Model 2 along with MGO. In this model the PAPGO emerged as the second predictor next to MGO in the sequence of predicting the IPS of high school students in Chemistry subject.

The third model derived from the regression shows significant increase in the amount of variance accounted by the next Predictor Variable, PAPGO to the IPS. In this model, the Predictor Variables; when MGO, PAPGO and ALS were taken against the IPS, which yielded a Coefficient of Multiple Correlations (*R*) of .519 with a Standard Error of the Estimate (SE_R) of 14.73. The Coefficient of Determination (R^2) of Model 3 is .269 and the Adjusted R^2 is .265. The R^2 value implied that 26.9% of the observed variance in the IPS scores is accounted by the collective contributions of MGO, PAPGO and ALS. The value of *F* obtained by the ANOVA method for the given R^2 in the model 3 is significant (R^2 =.269, $F(3, 575) = 70.49$, $p<.01$), since the calculated *F*- value exceeds the tabled value of *F* ($F(3, 575) = 3.80$).

The value of R^2 change is .011 which indicates that the increase in percentage variance accounted for the variable ALS to MGO and PAPGO is 1.1%. This model suggests that the predictor ALS is also significantly contributing to this model and it comes third in the sequence i.e. after MGO and PAPGO for predicting the IPS of high school students of Aided students.

The forth model derived from the Stepwise Regression Analysis shows changes in the amount of variance accounted by the next predictor variable, MA to the IPS. In this model, the Predictor Variables; MGO, PAPGO, ALS and MA are jointly taken against the IPS, which yielded a Coefficient of Multiple Correlations (*R*) of .528 with a Standard Error of the Estimate (SE_R) of 14.65. The Coefficient of Determination (R^2) of Model 4 is .278 and the Adjusted R^2 is

.273. The R^2 value implied that 27.8% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, ALS and MA. The value of F obtained by the ANOVA method for the given R^2 in the Model 4 is significant (R^2 = .278, F(4, 574) = 55.34, p<.01) since the calculated F- value exceeds the tabled value of F (F(4, 465) = 3.34).

The value of R^2 change is .009 which indicates that the increase in percentage variance accounted by the addition of MA to MGO, PAPGO and ALS is 0.9%. This suggests that the predictor MA is also significantly contributing to the derived model and which comes forth in the sequential order for predicting the IPS of Aided school students.

The fifth model derived from the Stepwise Regression Analysis shows significant increase in the amount of variance accounted by the next Predictor Variable, KLS to the IPS. In this model, the Predictors; MGO, PAPGO, ALS, MA, KLS are collectively taken against the IPS, that yielded a Coefficient of Multiple Correlations (R) of .535 with a Standard Error of the Estimate (SE_R) of 14.59. The Coefficient of Determination (R^2) of Model 5 is .286 and the Adjusted R^2 is .280. The R^2 explained that 28.6% of the observed variance in the IPS scores is accounted by the collective contribution of MGO, PAPGO, ALS, MA and KLS. The value of F obtained by the ANOVA method for the given R^2 in the Model 5 is significant (R^2= .286, F(5, 573) = 45.84, p<.01) since the calculated F- value exceeds the tabled value of F (F(5, 573) = 3.04).

The value of R^2 change is .007 which indicates that the increase in percentage variance accounted for the variable KLS to MGO, PAPGO, ALS and MA is 0.7%. This suggests that the predictor KLS is also significantly contributing to the derived model and which comes fifth position in the sequential order for predicting the IPS of high school students.

b) Coefficient Summary of the Predictor Variables; MGO, PAPGO, ALS, MA, and KLS on Integrated Process Skills in Chemistry for Aided Sample.

To understand the role of the individual Predictor Variables, the Standardized (beta) and the Unstanderdised (*B*) Regression Coefficients were further analysed and the regression equations are developed on the basis of these coefficients. The data and the results are presented in Table 91.

Table 91

Coefficient Summary for Regression of the Predictor Variables; MGO, PAPGO, ALS, MA, and KLS on Integrated Process Skills in Chemistry for the Aided Sample

Model		Un Standardized Coefficients		Standardized Coefficients	*t*
		B	Std. Error	beta	
1	(Constant)	20.227	7.423		
	MGO	1.223	.103	.443	11.857**
2	(Constant)	60.296	9.190		
	MGO	1.230	.099	.445	12.391**
	PAPGO	.539	.078	.249	6.923**
3	(Constant)	43.234	10.783		
	MGO	1.230	.099	.445	12.483**
	PAPGO	.529	.077	.244	6.830**
	ALS	.240	.081	.106	2.972**
4	(Constant)	55.604	11.637		
	MGO	1.248	.098	.451	12.702**
	PAPGO	.168	.061	.098	2.737**
	ALS	.498	.078	.230	6.402**
	MA	-.230	.080	-.102	-2.863**
5	(Constant)	61.716	11.855		
	MGO	1.250	.098	.452	12.785**
	PAPGO	.155	.061	.091	2.535*
	ALS	.467	.078	.215	5.954**
	MA	-.297	.084	-.131	-3.510**
	KLS	.199	.082	.092	2.439*

Note: **indicates $p<.01$; *indicates $p<.05$

Table 91 shows that the derived Model 1, the Unstanderdised Regression Coefficient (*B*) of MGO is 1.223 with a Standard Error of 0.10. Further β value presents Standardized Regression weight for MGO and which is found to be as 0.443. The critical ratio for *B* and beta value of MGO is statistically highly significant (t = 11.87, p<.01). It means that the individual contribution of MGO in predicting IPS in Chemistry is significant and the percentage of contribution of MGO to IPS is 19.6%. Therefore MGO is the most significant positive predictor of IPS in Chemistry of Aided Secondary School Students.

The equation to the regression line for predicting IPS in Chemistry (Y) by means of the predictor MGO (X2) can be written as IPS = 20.22 + 1.223MGO. This equation suggests that for 1.223 unit increases the Integrated Process Skills in Chemistry of Aided School students can be significantly predicted for every unit is increased in the Predictor MGO (X2) form this model.

Table 91 shows that for the Model 2, the Unstanderdised Regression Coefficient (*B*) is 1.23 for MGO and that of PAPGO is 0.539. The value of Standard Error of *B* for MGO is 0.099 and that of PAPGO is 0.078. Further β value presents Standardized Regression weight of MGO is 0.445 and that of PAPGO is 0.249. The critical ratios for the beta values of MGO (t =12.39) and PAPGO (t = 6.923) are statistically significant (p<.01). It means that the individual contributions of MGO and PAPGO in predicting IPS in Chemistry is highly significant and the percentage of individual contributions of MGO and PAPGO are 19.6% and 6.2% respectively. Hence the predictors MGO and PAPGO are identified as the significant positive predictors of IPS in Chemistry.

For Model 2, the equation to the regression line for predicting IPS in Chemistry (Y) by means of the predictors MGO (X2) and PAPGO (X3) can be presented as IPS = 60.296 + 1.23MGO + 0.539PAPGO. This equation suggests that for every unit increase in MGO (X2), the increase in IPS is 1.23 units when the effects of PAPGO is held constant and that for every unit increase in the PAPGO (X3) the IPS is increases by 0.539 units, only when the effect of the variable MGO is nullified.

Table 91 shows that for Model 3, the Unstanderdised Regression Coefficient (*B*) is 1.23 for MGO, 0.529 for PAPGO and that of ALS is -0.240. The value of Standard Error of B for MGO is 0.099, PAPGO is 0.077 and that of ALS is 0.081. Further β value presents standardized regression weight MGO is 0.445, PAPGO is 0.244 and that of ALS is 0.106. The critical ratio for the beta values of MGO (t = 12.48), PAPGO (t = 6.83), and ALS (t = 2.972) are statistically highly significant (p<.01). It means that the individual contributions of MGO, PAPGO and ALS in predicting the IPS in Chemistry of Aided students is significant and the corresponding percentages are 19.6%, 6.2% and 1.1% respectively. Therefore MGO, PAPAGO are Positive significant predictors and ALS is the negative Predictor of IPS in Chemistry.

For Model 3, the equation to the regression line for predicting IPS in chemistry (Y) by means of the predictor variables MGO(X2), PAPGO(X3) and ALS(X6) can be written as IPS = 43.24 + 1.23 MGO + 0.529 PAPGO + 0.240 ALS. This equation suggests that for unit increase in MGO, the increase in IPS is 1.23 units when the effects of PAPGO and ALS is held constant and that for unit increase in PAPGO the IPS is increases by 0.529 units, only when the effect of the variables MGO and ALS is nullified. Similarly for 0.240 units increase in the IPS of Aided students can be significantly predicted for every unit decrease in the ALS when the effects of MGO and PAPGO are held constant.

Table 91 shows that for the Model 4, the Unstanderdised Regression Coefficient (*B*) is 1.248 for MGO, 0.168 for MA, PAPGO is 0.498 and that of ALS is -0.230. The value of Standard Error of *B* for MGO is 0.098, MA is 0.061, PAPGO is 0.078 and that of ALS is 0.080. Further β value presents Standardized Regression weight of MGO is 0.451, MA is 0.098, PAPGO is 0.230 and that of ALS is -0.102 The critical ratios for the beta values are MGO (t = 12.07), PAPGO (t = 6.402), MA (t = 2.737), and ALS (t = 2.863) are statistically highly significant (p<.01). It means that the individual contributions of MGO, MA, PAGO and ALS in predicting the IPS in Chemistry is significant and the percentage of individual contributions are 19.6%, 6.2%, 1.1and 0.9% respectively. Among the predictors; the ALS is a negative significant predictor of IPS in Chemistry. Therefore MGO, MA, PAPGO and ALS are the significant predictors of IPS in Chemistry of Aided Secondary School Students.

For Model 4, the equation to the regression line for predicting Process Skills in Chemistry (Y) by means of the Predictor Variables; MGO(X2), MA(X1), PAPGO(X3), and ALS(X5) can be represented as IPS = 55.60 + 1.248MGO + 0.168MA + 0.498PAPGO - 0.230ALS. This equation suggests that for every unit increase in MGO, the increase in IPS is 1.248 units when the effects of MA, PAPGO and ALS are held constant and that for every unit increase in the MA the IPS is increases by 0.168 units, only when the effect of the variable MGO, PAPGO and ALS are nullified. Similarly for every unit increase in the PAPGO the IPS is increased by 0.498 units only when the effects of MGO, MA and ALS are nullified. But for every unit decrease in the predictor ALS the Integrated Process Skill is increased by 0.230 units when the effects of MGO, MA and PAPGO are held constant.

Table 91 revealed that for Model 5, the Unstanderdised Regression Coefficient (*B*) is 1.25 for MGO, 0.155 for MA, PAPGO is 0.467, ALS is -0.297 and that of KLS is 0.199. The value of Standard Error of *B* for MGO is 0.098, MA is 0.061, PAPGO is 0.078, ALS is 0.084 and that of KLS is 0.082. Further β value presents Standardized Regression weight of MGO is 0.45, MA is 0.091, PAPGO is 0.215, ALS is -0.131 and that of KLS is 0.092. The critical ratio for the beta values of MGO (t = 12.78), MA (t = 2.53), PAPGO (t = 5.95), ALS (t = 3.51), and KLS (t = 2.43) are highly significant (p<.01 & p<.05). It means that the individual contributions of MGO, MA, PAGO, ALS and VLS in predicting the IPS in chemistry is significant and the percentage of individual contributions are 19.6%, 6.2%, 1.1, 0.9% and 0.7% respectively. Therefore MGO, MA, PAPGO, ALS and KLS are the significant predictors of IPS in Chemistry of Aided Secondary School Students.

For Model 5, the equation to the regression line for predicting IPS (Y) by means of the Predictor Variables; MGO(X2), MA(X1), PAPGO(X3), ALS(X6) and KLS (X7) can be represented as IPS = 61.71 + 1.250MGO + 0.155MA + 0.467PAPGO - 0.297ALS + 0.199KLS. This equation suggests that for every unit increase in X2 (MGO), the increase in Y is 1.250 units when the effects of MA, PAPGO, ALS and KLS are held constant and that for unit increase in the X1(MA) the IPS is increases by 0.155 units, only when the effect of the variable MGO, PAPGO, ALS and KLS are nullified. Similarly for every unit increase in the X3 (PAPGO) the IPS is increased by 0.467 units only when the effects of MGO, MA, ALS and KLS are nullified. Where as in case of ALS; every unit decrease in the X6 (ALS) the IPS is increased by 0.297 units when the effects of MGO, PAPGO, MA and KLS are held constant and every unit increase in the X7 (KLS) the IPS is increased by 0.199 units when the effects of MGO, PAPGO, MA and ALS are held constant.

In brief, it can be said that out of seven Predictor Variables five variables are emerged as the significant predictors and therefore five models are derived out of the stepwise regression analysis. The Predictors; ***MGO, MA, PAPGO and KLS positively and significantly influencing the IPS whereas the Predictor; ALS is negatively influencing IPS of Aided students.*** But the Predictors; PAVGO and VLS is not influencing the IPS of Aided Secondary school students in the Subject of Chemistry.

CHAPTER 5

Summary of Findings and Suggestions

- *Study in Retrospect*
- *Major Findings of the Study*
- *Tenability of Hypotheses*
- *Conclusion of the Study*
- *Educational Implications Derived*
- *Suggestions for Further Research*

In this chapter an overview of the important aspects of the stages of executing the study, the major findings of the study, conclusion of the study, suggestion for improving educational practices and suggestion for further research were presented in brief. This chapter is organised under the following headings:

Study in Retrospect

Major Findings of the Study

Tenability of Hypotheses

Conclusion of the Study

Educational Implications Derived

Suggestions for Further Research

Study in Retrospect

Significant aspects pertaining to the different phases of the present study like the Statement of the Problem, Variables, Objectives, Hypotheses, and Methodology followed etc. are given in retrospect.

Restatement of the Problem

The present study is intended to find out the influence of three Predictor Variables; Metacognitive Awareness, Goal Orientation and Learning Styles on Criterion Variables; Basic and Integrated Process Skills in Chemistry among Secondary School Students. Hence the present study is restated as **Influence of Metacognitive Awareness, Goal Orientation and Learning Styles on Process Skills in Chemistry of Secondary School Students.**

Variables Selected for the Study

The Predictor Variables and the Criterion Variables selected for the study are the following:

Predictor Variables.

1. Metacognitive Awareness
2. Goal Orientation
3. Learning Styles

Criterion Variables.

1. Basic Process Skills in Chemistry
2. Integrated Process Skills in Chemistry

Classificatory Variables

Classificatory variables selected for the presented study are as follows.

- Gender
- Locality of the Institution
- Type of Management of the Institution

Objectives of the Study

The study was done with the following objectives under consideration:

1. To find out the level of Metacognitive Awareness among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
2. To find out the extent of Goal Orientation among Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

3. To find out the Learning Style Preferences of Secondary School Students for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

4. To study whether there exist any significant differences in the mean scores of Metacognitive Awareness and its Levels between the subsamples based on Gender, Locale and Type of Management of the Institution.

5. To study whether there exist any significant differences in the mean scores of Mastery Goal Orientation (MGO), Performance- Approach Goal Orientation (PAPGO) and Performance-Avoidance Goal Orientation (PAVGO) between the subsamples based on Gender, Locale and Type of Management of the Institution.

6. To study whether there exist any significant differences in the mean scores of Visual Learning Style (VLS), Auditory Learning Style (ALS) and Kinesthetic Learning Style (KLS) between the subsamples based on Gender, Locale and Type of Management of the Institution.

7. To study whether there exist any significant differences in the mean scores of Basic Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

8. To study whether there exist any significant differences in the mean scores of Integrated Process Skills in Chemistry between the subsamples based on Gender, Locale and Type of Management of the Institution.

9. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

   (ii) To estimate the Multiple Correlation(R) between significant predictors and the Criterion Variable, Basic Process Skills in Chemistry.

   (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Basic Process Skills in Chemistry for the Total sample and subsamples based on Gender, Locale and Type of Management the Institution.

10. (i) To study whether Metacognitive Awareness, Goal Orientation and Learning Styles are the significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

    (ii) To estimate the Multiple Correlation (R) between significant predictors and the Criterion Variable; Integrated Process Skills in Chemistry.

    (iii) To estimate the relative efficiency of the individual and combined contribution of significant predictors in predicting Integrated Process Skills in Chemistry for the Total sample and the subsamples based on Gender, Locale and Type of Management the Institution.

Hypotheses of the Study

The present study was designed to test the following hypotheses:

1. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Gender.
2. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Locale of the Institution.
3. There will be significant difference in the mean scores of Metacognitive Awareness and its Levels between the sub samples based on Type of Management of the Institution.
4. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Gender.
5. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Locale of the Institution.
6. There will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation between the sub samples based on Type of Management of the Institution.
7. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Gender.

8. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Locale of the Institution.
9. There will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Type of Management of the Institution.
10. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Gender.
11. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Locale of the Institution.
12. There will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Type of Management of the Institution.
13. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Gender.
14. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Locale of the Institution.
15. There will be significant difference in the mean scores of Integrated Process Skills in Chemistry for the sub samples based on Type of Management of the Institution.
16. Metacognitive Awareness, Goal Orientation and Learning Styles will be the significant predictors in predicting the Criterion Variable;

Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

17. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
18. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Basic Process Skills in Chemistry for the Total sample and the subsample based on Gender, Locale and Type of Management of the Institution.
19. Metacognitive Awareness, Goal Orientation and Learning Styles will be significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
20. There will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.
21. The relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Integrated Process Skills in Chemistry for Total sample and subsample based on Gender, Locale and Type of Management of the Institution.

Methodology

The present study made use of the Survey design and the details of methodology followed is outlined in the following section.

Sample of the Study.

The present study was conducted on a representative sample of 980 Secondary School Students selected from Kollam, Thirssur, Palakkad, Malappuram, Kozhikode and Kannur Districts of Kerala. Due weightage was given to the relevant subgroups of the population based on Gender, Locale and Type of Management of the Institution. Stratified Random Sampling Technique was used for the selection of the sample.

Tools Used for the Study.

The present study used the following tools.

Scale of Metacognitive Awareness (Hameed, Sabna & Meharunnisa, 2014).

This tool was used to assess the Metacognitive Awareness of Secondary School Students. It was a three point scale with 66 items in the draft and the final scale consist of 53 items, developed and standardised by the investigators. It followed the theoretical frameworks of Flavell's Theory of Metacognition with six components viz; Knowledge of Self, Preparation and planning for learning, Conditional Knowledge, Selecting and using learning strategies, Monitoring and evaluating strategies and Evaluation of self.

Scale of Goal Orientation (Hameed & Meharunnisa, 2014).

This instrument was used to find out the type of goals adopted by Secondary School Students in certain achievement situations. It was a five point scale with 61 items in the draft and 38 items in the final scale, developed and standardized by the investigators. Items were constructed on the basis of Achievement Goal Theories of Dweck (1986); Ames (1992) and Pintrich (2000). Components of the Scale of Goal Orientation were Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance-Avoidance Goal Orientation.

Learning Style Inventory (Hameed & Meharunnisa, 2014).

The inventory was intended to investigate the most appropriate Learning Style chosen by Secondary School Students in the learning process. It was a three point scale with 75 items in the draft and 52 items in the final scale, developed and standardized by the investigators. Items of the Inventory were constructed on the basis of classification followed by Dunn and Dunn Model of Learning Style (1999), Fleming (1992) and Reid (1987). Components of Learning Style Inventory were Visual Learning Style, Auditory Learning Style, and Kinesthetic Learning Style.

Test of Basic Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test was meant to measure the Basic Process Skills in Chemistry of Secondary School Students. It was an objective type test with 60 items in the draft and the final test consist of 36 items which measures seven Basic Process

Skills. The skills measured using the test were; Skill of Observing, Communicating, Comparing/classifying, Using Number Relation, Measuring, Predicting and Inferring. The tool was constructed and validated by the investigators.

Test of Integrated Process Skills in Chemistry (Hameed & Meharunnisa, 2014).

This test was meant to measure the Integrated Process Skills in Chemistry of the Students in Secondary Schools. It was an objective type test with 43 items in the draft and 33 items in the final test, which measures five Integrated Process Skills. The skills measured by the test were; Skill of Hypothesizing, Controlling Variables, Analysing, Interpreting data and Generalising. The tool was also constructed and validated by the investigators.

Statistical Techniques Used for the Study.

The present study was quantitative one and the investigators used both descriptive and inferential statistics for the analysis. The major statistical techniques used for the present study can be summarised as follows:

Basic Descriptive Statistics.

Mean, Median, Mode, Standard Deviation, Skewness and Kurtosis of each Variable for the Total sample and relevant subsamples based on Gender, Locale and Type of Management of the Institution were calculated as preliminary analysis.

Mean Difference Analysis.

Test of Significance of Difference between Large Independent Sample was used to compare the mean scores of all the Predictor Variables and the Criterion Variables based on Gender, Locale and Type of Management of the Institution.

Multiple Regression Analysis.

Step Wise Multiple Regression Analysis was employed to find out the significant predictors of Basic and Integrated Process Skills in Chemistry and to identify the relative efficiency (Individually and Collectively) of Predictor Variables; Metacognitive Awareness, Goal Orientation and Learning Styles on Basic and Integrated Process Skills in Chemistry of Secondary School Students. Regression Prediction equation was also developed to predict the score of Basic and Integrated Process Skills in Chemistry from a given score of Predictor Variables.

Major Findings of the Study

Findings of the study were summarised and presented in this section of the report, under different headings as the Findings of Percentage Analysis, Findings of Mean Difference Analysis and Findings of Multiple Correlation and Step Wise Regression Analysis.

Result of Percentage Analysis.

Percentage Analysis was employed in the study as a preliminary step to investigate the level of Metacognitive Awareness for the Total sample and the Subsamples based on Gender, Locale and Type of Management of the

Institution. Results of the Percentage Analysis are briefly presented in the section as follows.

Extent of the Level of Metacognitive Awareness.

- For Total sample of Secondary School Students, 67% possess moderate level of Metacognitive Awareness, 21% are having high level of Metacognitive Awareness and 12% possess low level of Metacognitive Awareness.
- For Male Secondary School Students, 69% possess moderate level of Metacognitive Awareness, 20% possess high Metacognitive Awareness and 11% are having low Metacognitive Awareness level.
- For Female Secondary School Students, 66% are with moderate level of Metacognitive Awareness, 22% possess high Metacognitive Awareness and 12% are having low Metacognitive Awareness.
- For Urban Secondary School Students, 68% possess moderate level of Metacognitive Awareness, 20% are high in their Metacognitive Awareness and 12% are with low Metacognitive Awareness.
- For Rural Secondary School Students, 66% possess moderate level of Metacognitive Awareness, 22% are with high Metacognitive Awareness and 12% possess low Metacognitive Awareness.
- For Government Secondary School Students, 65% possess moderate Metacognitive Awareness, 22% are having high Metacognitive Awareness and 13% possess low level of Metacognitive Awareness.
- For Aided Secondary School Students, 68% possess moderate Metacognitive Awareness, 20% are with high Metacognitive Awareness and 12% possess low Metacognitive Awareness.

Extent of Goal Orientation.

- For Total sample of Secondary School Students, most preferred Goal Orientation is Performance-Approach Goal, second most preferred goal is Mastery goal and their least preferred goal is Performance-Avoidance goal.
- For Male Secondary Schools Students, most preferred goal is Mastery goal, the second most preferred goal is Performance-Approach goal and their least preferred goal is Performance-Avoidance goal.
- For Female Secondary School Students, the most preferred goal is Performance-Approach goal, the second most preferred goal is Mastery goal and their least preferred goal is Performance-Avoidance goal.
- For Urban Secondary School Students, the most preferred goal is Performance-Approach Goal Orientation, the second most preferred goal is Mastery goal and the least preferred goal of Urban Secondary School Students is Performance-Avoidance goal.
- For Rural Secondary School Students, the most preferred goal is Performance-Approach goal, the second most preferred goal is Mastery goal and the least preferred goal is Performance-Avoidance goal.
- For Government Secondary School Students, most preferred goal is Performance-Approach Goal Orientation, the second most preferred goal is Mastery goal and their least preferred goal is Performance-Avoidance goal
- For Aided Secondary School Students, their most preferred goal is Performance-Approach Goal Orientation, the second most preferred

goal is Mastery goal and their least preferred goal is Performance-Avoidance goal.

Extent of Learning Styles.

- For Total sample of Secondary School Students, the most preferred Learning Style is Visual Learning Style, the second most preferred Style is Kinesthetic and the least preferred Learning Style is Auditory Style.
- For Male Secondary Schools Students, the most preferred Learning Style is Visual Style and they show almost equal preference towards Auditory and Kinesthetic Learning Styles.
- For Female Secondary School Students, the most preferred Learning Style is Visual Learning Style, the second most preferred Style is Kinesthetic Learning Style and their least preferred Learning Style is Performance-Avoidance goal.
- For Urban Secondary School Students, the most preferred Learning Style is Visual Learning Style, the second most preferred Style is Kinesthetic Learning Style and their least preferred Learning Style is Auditory Learning Style.
- For Rural Secondary School Students, the most preferred Learning Style is Visual Learning Style and they show almost equal preference of Auditory and Kinesthetic Learning Styles.
- For Government Secondary School Students, the most preferred leaning style is Visual Learning Style. The second most preferred Learning Style of Government students are Kinesthetic Learning Style and their least preferred Learning Style is Auditory Learning Style.

- For Aided Secondary School Students, the most preferred Leaning Style is Visual Learning Style; they show almost equal preference towards Auditory and Kinesthetic Learning Styles.

Results of Mean Difference Analysis

Mean Difference Analysis was employed to know whether there exist any significant difference between Male and Female, Rural and Urban and Government and Aided Secondary School Students for the Predictor Variables; Metacognitive Awareness, Goal Orientation, Learning Styles and the Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry of Secondary School Students.

Gender Difference in Predictor Variables.

Mean Difference Analysis based on the Gender of Secondary Schools Students were done for Predictor Variables; Metacognitive Awareness and its levels (HMA, MMA & LMA), Goal Orientation (MGO, PAPGO & PAVGO), and Learning Styles (VLS, ALS & KLS) and the findings were summarised as follows:

- There exist significant difference between Male and Female Secondary School Students in High Metacognitive Awareness level (t = 2.48, p<.05).
- There is no significant difference exist between Male and Female Secondary School Students in Metacognitive Awareness (t = 0.56, p>.01).

- There is no significant difference exist between Male and Female Secondary School Students in Moderate Metacognitive Awareness Level (t = 0.75, p>.01).
- There is no significant difference exist between Male and Female Secondary School Students in Low Metacognitive Awareness Level (t = 0.09, p>.01).
- There exist significant difference between Male and Female Secondary School Students in Performance-Approach Goal Orientation (t = 2.38, p<.05).
- There is no significant difference exist between Male and Female Secondary School Students in Mastery Goal Orientation (t = 0.71, p>.01).
- There is no significant difference exist between Male and Female Secondary School Students in Performance-Avoidance Goal Orientation (t = 1.23, p>.01).
- There exist significant difference between Male and Female Secondary School Students in Visual Learning Style (t = 3.07, p<.01).
- There exist significant difference between Male and Female Secondary School Students in Auditory learning Style (t = 1.98, p<.05).
- There exist no significant difference between Male and Female Secondary School Students in kinesthatic Learning Style (t = 0.06, p>.01).

Gender Differences in Criterion Variables.

The mean difference analysis based on the Gender of secondary schools students were done for Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry and the findings were summarised as follows:

- There exist significant difference between Male and Female Secondary School Students in Basic Process Skills in Chemistry (t = 2.01, p<.05).
- There is no significant difference exist between Male and Female Secondary School Students in Integrated Process Skills in Chemistry (t = 0.21, p>.01).

Locality Difference in Predictor Variables.

Mean Difference Analysis based on the Locale of Secondary Schools Students were done for Predictor Variables; Metacognitive Awareness and its levels (HMA, MMA and LMA), Goal Orientation (MGO, PAPGO & PAVGO), and Learning Styles (VLS, ALS & KLS) and the findings were summarised as follows:

- There is no significant difference exist between Urban and Rural Secondary School Students in Metacognitive Awareness (t = 0.62, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in High Metacognitive Awareness level (t = 0.59, p>.01).

- There is no significant difference exist between Urban and Rural Secondary School Students in Moderate Metacognitive Awareness Level (t = 0.25, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in Low Metacognitive Awareness Level (t = 1.02, p>.01).
- There exist significant difference between Urban and Rural Secondary School Students in Performance-Approach Goal Orientation (t = 1.05, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in Mastery Goal Orientation (t = 1.61, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in Performance-Avoidance Goal Orientation (t = 0.10, p>.01).
- There exist significant difference between Urban and Rural Secondary School Students in Visual Learning Style (t = 0.03, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in Auditory Learning Style (t=0.28, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in kinesthatic Learning Style (t = 1.60, p>.01).

Locality Differences in Criterion Variables.

The mean difference analysis based on the Locale of Secondary Schools Students were done for Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry and the findings were summarised as follows:

- There is no significant difference exist between Urban and Rural Secondary School Students in Basic Process Skills in Chemistry (t = 1.65, p>.01).
- There is no significant difference exist between Urban and Rural Secondary School Students in Integrated Process Skills in Chemistry (t = 0.83, p>.01).

Management Difference in Predictor Variables.

Mean Difference Analysis based on the Type of Management of the Institution of Secondary Schools Students were done for Predictor Variables; Metacognitive Awareness and its levels (HMA, MMA and LMA), Goal Orientation (MGO, PAPGO & PAVGO), and Learning Styles (VLS, ALS & KLS) and the findings were summarised as follows:

- There is no significant difference exist between Government and Aided Secondary School Students in Metacognitive Awareness (t = 1.12, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in High Metacognitive Awareness Level (t = 0.80, p>.01).

- There is no significant difference exist between Government and Aided Secondary School Students in Moderate Metacognitive Awareness Level (t = 0.89, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in Low Metacognitive Awareness Level (t = 1.27, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in Performance-Approach Goal Orientation (t = 0.78, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in Mastery Goal Orientation (t = 1.29, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in Performance-Avoidance Goal Orientation (t = 0.34, p>.01).
- There exist significant difference between Government and Aided Secondary School Students in Visual Learning style (t = 1.98, p<.05).
- There is no significant difference exist between Government and Aided Secondary School Students in Auditory Learning Style (t = 0.25, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in kinesthatic Learning Style (t = 0.78, p>.01).

Management Difference in Criterion Variable.

The mean difference analyses based on the Type of Management the Institution of Secondary Schools Students were done for Criterion Variables; Basic Process Skills in Chemistry and Integrated Process Skills in Chemistry and the findings were summarised as follows:

- There is no significant difference exist between Government and Aided Secondary School Students in Basic Process Skills in Chemistry (t = 1.54, p>.01).
- There is no significant difference exist between Government and Aided Secondary School Students in Integrated Process Skills in Chemistry (t = 0.08, p>.01).

Results of Multiple Correlation Analysis.

The Multiple Correlation analysis using Pearsons' Product Moment Coefficient of Correlation method was employed to identify the nature and strength of the relationship between the Predictor Variables; and the Criterion Variables.

The Coefficient of Correlation (r) for Metacognitive Awareness, Mastery Goal Orientation, Performance-Approach Goal Orientation, Performance-Avoidance Goal Orientation, Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style with Basic and Integrated Process Skills in Chemistry for the Total sample and subsamples based on Gender, Locale and Type of Management of the Institution were summarised as follows:

Relationship of the Predictor Variables with Basic Process Skills in Chemistry for Total Sample.

- There exist significant positive relation between MA and BPS in Chemistry of Secondary School Students.
- In case of Goal Orientation of Secondary School Students, there exist significant positive relation between MGO and BPS in Chemistry, PAPGO exhibits significant positive relation with BPS in Chemistry and PAVGO is not significantly correlated with BPS in Chemistry.
- In case of Learning Styles of Secondary School Students; there exist significant and positive correlation between VLS and BPS, ALS is significantly and negatively correlated with BPS and KLS is not significantly correlated with BPS in Chemistry.

Relationship of the Predictor Variables with Basic Process Skills in Chemistry for the sub sample based on Gender.

- MA is not significantly correlated with Basic Process Skills in Chemistry of Male Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS in Chemistry and the PAVGO is not significantly correlated with BPS in Chemistry of Male Secondary School Students.
- In case of Learning Styles, VLS is not significantly correlated with BPS, ALS is significantly and negatively correlated and KLS is not correlated with BPS in Chemistry of Male Secondary School Students.

- MA has significant and positive correlation with BPS in Chemistry of Female Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS and PAVGO is not correlated with BPS in Chemistry of Female Secondary School Students.
- In case of Learning Styles, VLS is not significantly correlated with BPS, ALS is significantly and negatively correlated and KLS is not correlated with BPS Chemistry of Female Secondary School Students.

Relationship of the Predictor Variables with Basic Process Skills in Chemistry for the sub sample based on Locale of the Institution.

- MA is significantly and positively related with BPS in Chemistry of Urban Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS and PAVGO is not correlated with BPS in Chemistry of Urban Secondary School Students.
- In case of Learning Styles, VLS is not significantly correlated with BPS, ALS is significantly and negatively correlated and KLS is not correlated with BPS in Chemistry Urban Secondary School Students.
- MA is not significantly correlated with BPS in Chemistry of Rural Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS and PAVGO had significant and negative correlation with BPS in Chemistry of Rural Secondary School Students.

- In case of Learning Styles, VLS is not significantly correlated with BPS, ALS is significantly and negatively correlated and KLS is not significantly correlated with BPS in Chemistry of Rural Secondary School Students.

Relationship of the Predictor Variables with Basic Process Skills in Chemistry for the sub sample based on Type of Management of the Institution.

- MA has significant positive correlation with BPS in Chemistry of Government Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS and PAVGO does not show significant correlation with BPS in Chemistry of Government Secondary School Students.
- In case of Learning Styles, VLS has significant and positive correlation with BPS, ALS is significantly and negatively correlated and KLS is not significantly correlated with BPS in Chemistry of Government Secondary School Students.
- MA is not significantly correlated with BPS in Chemistry of Aided Secondary School Students.
- In Goal Orientation, MGO and PAPGO exhibit significant positive relation with BPS in Chemistry and PAVGO does not show significant correlation with BPS in Chemistry of Aided Secondary school Students.

- In case of Learning Styles, VLS is not significantly related with BPS, ALS is significantly and negatively correlated and KLS is not significantly correlated with BPS in Chemistry of Aided Secondary school Students.

Relationship of the Predictor Variables with Integrated Process Skills in Chemistry for Total Sample.

- MA has significant and positive correlation with Integrated Process Skills in Chemistry of Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS and PAVGO is not significantly correlated with IPS in Chemistry of Secondary School Students.
- In case of Learning Styles, VLS is not significantly correlated with IPS, ALS is significantly and negatively correlated and KLS had significant and positive correlation with IPS in Chemistry of Secondary School Students.

Relationship of the Predictor Variables with Integrated Process Skills in Chemistry for the sub sample based on Gender.

- MA has significant and positive correlation with IPS in Chemistry of Male Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS in Chemistry and PAVGO has significant negative correlation with IPS in Chemistry of Male Secondary School Students.

- In case of Learning Styles, VLS is not significantly correlated with IPS, ALS is significantly and negatively correlated and KLS had significant and positive correlation with IPS in Chemistry of Male Secondary School Students.
- MA had significant and positive correlation with IPS in Chemistry of Female Secondary school Students.
- In case of Goal Orientations, MGO and PAPGO exhibit significant positive relation with IPS and PAVGO is not correlated with IPS in Chemistry of Female Secondary school Students.
- In case of Learning Styles, VLS had significant positive correlation with IPS, ALS is significantly and negatively correlated and KLS had significant and positive correlation with IPS in Chemistry of Female Secondary school Students.

Relationship of the Predictor Variables with Integrated Process Skills in Chemistry for the sub sample based on Locale of the Institution.

- MA has significant and positive correlation with IPS in Chemistry of Urban Secondary School Students.
- In Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS and PAVGO is not correlated with IPS in Chemistry of Urban Secondary School Students.
- In case of Learning Style, VLS has positive and significant correlation with IPS, ALS is significantly and negatively correlated and KLS had

significant and positive correlation with IPS in Chemistry of Urban Secondary School Students.

- MA has positive and significant correlation with Integrated Process Skills in Chemistry of Rural Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS in Chemistry and PAVGO has significant and negative correlation with IPS in Chemistry of Rural Secondary School Students.
- In case of Learning Style, VLS is not significantly correlated with IPS, ALS is significantly and negatively correlated and KLS had significant and positive correlation with IPS of Rural Secondary School Students.

Relationship of the Predictor Variables with Integrated Process Skills in Chemistry for the sub sample based on Type of Management of the Institution.

- MA has significant positive correlation with IPS in Chemistry of Government Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS in Chemistry and PAVGO does not show significant correlation with IPS in Chemistry Government Secondary School Students.
- In case of Learning Styles, VLS is not significantly correlated with IPS, ALS is significantly and negatively correlated and KLS has significant and positive correlation with IPS in Chemistry Government Secondary School Students.

- MA has positive and significant correlation with IPS in Chemistry Aided Secondary School Students.
- In case of Goal Orientation, MGO and PAPGO exhibit significant positive relation with IPS in Chemistry and PAVGO does not show significant correlation with IPS in Chemistry Aided Secondary School Students.
- In case of Learning Styles, VLS is not significantly related with IPS, ALS is significantly and negatively correlated and KLS had significant and positive correlation with IPS in Chemistry Aided Secondary School Students.

Results of Multiple Regression Analysis

Multiple Regression Analysis using Stepwise Method has been employed to find out the significant predictors, their relative efficiency (individual and joint contributions) in predicting Criterion Variables; Basic and Integrated Process Skills in Chemistry for Total sample and the subsamples based on Gender, Locale and Type of Institution of Secondary School Students. The results are summarised as follows.

Relative Efficiency of Predictor Variables in Predicting the Basic Process Skills in Chemistry for Total Sample.

- MGO is the most potential predictor of Basic Process Skills in Chemistry. The variance explained by MGO is 13.2%, which is significant (F = 149.22, p<.01).
- PAPGO, emerged as the second important predictor of BPS. MGO and PAPGO together explained 15.1% of variance in BPS (F = 86.75, p<.01); of which PAPGO individually contributed 1.9% variance.

- MA, emerged as the third important predictor of BPS; MGO, PAPGO and MA collectively explained 15.8% of variance in BPS (F = 60.90, p<.01); of which MA individually contributed 0.7% variance.
- VLS, emerged as the fourth important predictor of BPS and MGO, PAPGO, MA and VLS together explained 16.6% of variance in BPS (F=48.43, p<.01); of which VLS individually contributed 0.8% of variance.
- The remaining 83.4% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence, the linear combination of four significant predictor variables (MGO, PAPGO, MA & VLS) made a significant influence on BPS in Chemistry.
- The PAVGO, ALS and KLS are excluded and they were not entered as the significant predictors of BPS in Chemistry for the Total sample.
- Regression Coefficients show that the individual contributions of four significant predictors MGO (β =.355, p<.01), PAPGO (β =0.149, p<.01), MA (β = 0.097, p<.01) and VLS (β = 0.094, p<.01) has significant positive influence upon BPS. Therefore high MGO, high PAPGO, high MA and VLS lead students towards high BPS in Chemistry.
- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO, PAPGO, MA and VLS, the regression prediction equation developed is given by;

$$BPS = 5.19+0.697MGO+0.297PAPGO+0.155MA+0.178VLS$$

Relative Efficiency of Predictor Variables in Predicting the Basic Process Skills in Chemistry on the basis of Gender.

- MGO is the most potential predictor of BPS in Chemistry of Male Secondary School Students. The variance explained by MGO is 16.9%, which is significant (F = 83.42, p<.01).
- PAPGO, emerged as the second important predictor of BPS. MGO and PAPGO together explained 18.3% of variance in BPS (F = 45.94, p<.01); of which PAPGO individually contributed 1.4% variance.
- The remaining 81.7% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence, the linear combination of only two significant Predictor Variables (MGO & PAPGO) made a significant influence on BPS in Chemistry.
- MA, PAVGO, VLS, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for Male students.
- Regression Coefficients show that the individual contributions of two significant predictors MGO (β = 0.399, p<.01) and PAPGO (β = 0.121, p<.01), MA (β =0.097, p<.01) and VLS (β = 0.094, p<.01) has significant positive influence upon BPS. Therefore Male students with high MGO and high PAPGO tend to have high BPS in Chemistry.
- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO and PAPGO the regression prediction equation developed for Male students is given by;

$$BPS = 2.321+0.770MGO+ 0.232PAPGO$$

- MGO is the most potential predictor of BPS in Chemistry for the Female students. The multiple regression factor (R^2) show that 11.1% of the variance was explained by MGO (F = 70.639, p<.01).
- PAPGO emerged as the second important predictor of BPS. MGO and PAPGO together explained 13.1% of variance in BPS (F = 42.742, p<.01); of which PAPGO individually contributed 2.0% variance. MA emerged as the third important predictor of BPS. MGO, PAPGO and MA combined explained 14.3% of variance in BPS (F = 31.359, p<.01); of which MA individually contributed 1.2% variance.
- VLS emerged as the fourth important predictor of BPS and MGO, PAPGO, MA and VLS together explained 15.8% of variance in BPS (F = 26.335, p<.01); of which VLS individually contributed 1.5% of variance.
- The remaining 85.2% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence the linear combination of four significant Predictor Variables (MGO, PAPGO, MA & VLS) made a significant influence on BPS in Chemistry.
- The PAVGO, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for the Female sample.
- Regression Coefficients show that the individual contributions of four significant predictors MGO (β = 0.324), PAPGO (β = 0.160, p<.01), MA (β = 0.130, p<.01) and VLS (β = 0.128, p<.01) had

significant positive influence upon BPS in Chemistry for the Female sample. Therefore high MGO, high PAPGO, high MA and VLS lead students towards high BPS in Chemistry in Female students.

- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO, PAPGO, MA and VLS developed is given by;

$$BPS = 7.64+0.614\ MGO+0.326PAPGO+0.214\ MA+0.241VLS$$

Relative Efficiency of Predictor Variables in Predicting the Basic Process Skills in Chemistry on the basis of Locale of the Institution.

- MGO is the most potential predictor of Basic Process Skills in Chemistry for Urban students. The variance explained by MGO is 11.3% which is significant (F = 59.37, p<.01).
- VLS emerged as the second important predictor of BPS; MGO and VLS together explained 12.4% of variance in BPS (F = 33.12, p<.01); of which VLS individually contributed 1.2% variance.
- PAPGO emerged as the third important predictor of BPS; MGO, VLS and PAPGO combined explained 14.1% of variance in BPS (F = 25.51, p<.01); of which PAPGO individually contributed 1.7% variance. MA emerged as the fourth important predictor of BPS and MGO, VLS, PAPGO, and MA together explained 15.5% of variance in BPS (F= 21.25, p<.01); of which VLS individually contributed 1.3% of variance.
- The remaining 85.5% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence the

linear combination of four significant Predictor Variables (MGO, VLS, PAPGO & MA) made a significant influence on BPS in Chemistry.

- The PAVGO, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for the Urban Students.
- Regression Coefficients show that the individual contributions of four significant predictors MGO (β = 0.314, p<.01), VLS (β = 0.160, p<.01), PAPGO (β = 0.131, p<.01) and MA (β = 0.117, p<.01) has significant positive influence upon BPS in Chemistry for the Urban Students. Therefore high MGO, high VLS, PAPGO, and high MA lead students towards high BPS in Chemistry among Urban students.
- For estimating the BPS in Chemistry using weighted linear combination of significant predictors; MGO, VLS, PAPGO, and MA for Urban Secondary Students is given by;

$$BPS = 19.07+0.604MGO+0.314VLS+0.268PAPGO+0.199MA$$

- MGO is the most potential predictor of BPS in Chemistry for the Rural Students. The variance was explained by MGO is 15.4% which is significant (F = 92.21, p<.01).
- PAPGO emerged as the second important predictor of BPS; MGO and PAPGO together explained 18.4% of variance in BPS (F = 57.34, p<.01); of which PAPGO individually contributed 3.1% variance.

- The remaining 81.6% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence the linear combination of two significant Predictor Variables (MGO & PAPGO) made a significant influence on BPS in Chemistry.
- The MA, PAVGO, VLS, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for the Rural Students.
- Regression coefficients show that the individual contributions of two significant predictors MGO (β = 0.375, p<.01) and PAPGO (β = 0.176, p<.01), has significant positive influence upon BPS in Chemistry in Rural students. Therefore Rural students with high MGO and high PAPGO tend to have high BPS in Chemistry.
- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO and PAPGO developed for Rural sample is given by;

$$BPS = 21.21+0.711MGO+ 0.343PAPGO$$

Relative Efficiency of Predictor Variables in Predicting Basic Process Skills in Chemistry on the basis of Type of Management the Institution.

- MGO was the most potential predictor of BPS in Chemistry for the Government sample. The variance explained by MGO 14.7%, which is significant (F = 68.82, p<.01).
- MA emerged as the second important predictor of BPS; MGO and MA together explained 16.7% of variance in BPS (F = 39.76, p<.01); of which MA individually contributed 1.9% variance.

- VLS emerged as the third important predictor of BPS.; MGO, MA and VLS combined explained 17.6% of variance in BPS (F = 28.34, p<.01); of which VLS individually contributed 1.0% variance.
- PAPGO emerged as the fourth important predictor of BPS and MGO, MA, VLS, and PAPGO together explained 18.7% of variance in BPS (F = 22.80, p<.01); of which PAPGO individually contributed 1.1% of variance.
- The remaining 81.3% of variation in BPS is attributable to variation in other variables that have not been included in this study. The linear combination of four significant Predictor Variables (MGO, MA, VLS & PAPGO) made a significant influence on BPS in Chemistry.
- The PAVGO, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for the Government students.
- Regression Coefficients show that the individual contributions of four significant predictors MGO (β = 0.380, p<.01), MA (β = 0.153, p<.01), VLS (β = 0.130, p<.01), and PAPGO (β = 0.184, p<.01) has significant positive influence upon BPS in Chemistry for the Government sample. Therefore high MGO, high MA, high VLS, and PAPGO lead students towards high BPS in Chemistry among Government students.
- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO, MA, VLS and PAPGO,

the regression equation developed for Government students is given by;

BPS = 16.54+0.572MGO+0.248MA+0.252VLS+0.214PAPGO

- MGO was the most potential predictor of BPS in Chemistry for the Aided Students. The variance explained by MGO is 13.3%, which is significant (F = 88.85, p<.01).
- PAPGO emerged as the second important predictor of BPS; MGO and PAPGO together explained 16.7% of variance in BPS (F = 57.83, p<.01); of which PAPGO individually contributed 3.4% variance.
- The remaining 83.3% of variation in BPS is attributable to variation in other variables that have not been included in this study. Hence, the linear combination of only two significant Predictor Variables (MGO & PAPGO) made a significant influence on BPS in Chemistry.
- MA, PAVGO, VLS, ALS and KLS are excluded and they were not significant predictors of BPS in Chemistry for the Aided students.
- Regression Coefficients show that the individual contributions of two significant predictors MGO (β = 0.367, p<.01) and PAPGO (β = 0.184, p<.01), has significant positive influence upon BPS in Chemistry in Aided students. Therefore Aided students with high MGO and high PAPGO tend to have high BPS in Chemistry.
- For estimating the BPS in Chemistry by using weighted linear combination of significant predictors; MGO and PAPGO the regression prediction equation for Aided students is given by;

BPS = 20.23+0.941MGO+ 0.370PAPGO

Relative Efficiency of Predictor Variables in Predicting Integrated Process Skills in Chemistry for Total Sample.

- MGO is the most potential predictor of IPS in Chemistry of Secondary School Students. The variance explained by MGO is 16.5%, which is significant (F = 192.74, p<.01).
- PAPGO emerged as the second important predictor of IPS; MGO and PAPGO together explained 19.5% of variance in IPS (F = 118.53, p<.01); of which PAPGO individually contributed 3.1% variance. MA emerged as the third important predictor of IPS; MGO, PAPGO and MA combined explained 21.8% of variance in IPS (F = 90.85, p<.01); of which MA individually contributed 2.3% variance.
- VLS emerged as the fourth important predictor of IPS and MGO, PAPGO, MA and VLS together explained 22.6% of variance in IPS (F = 70.98, p<.01); of which VLS individually contributed 0.7% of variance.
- ALS emerged as the fifth important predictor of IPS and MGO, PAPGO, MA, VLS and ALS together explained 23.0% of variance in IPS (F = 58.31, p<.01); of which ALS individually contributed 0.5% of variance.
- KLS emerged as the sixth important predictor of IPS and MGO, PAPGO, MA, VLS, ALS and KLS together explained 23.9% of variance in IPS (F = 50.93, p<.01); of which KLS individually contributed 0.5% of variance.
- The remaining 76.1 percent variance in IPS in Chemistry is contributed by variables other than the Predictor Variables selected

for the study. Hence it is evident that linear combination of six significant Predictor Variables (MGO, PAPGO, MA, VLS, ALS & KLS) made a significant influence on IPS in Chemistry.

- The PAVGO is the only predictor which is excluded and identified as a non significant predictor of IPS for Total sample.
- Regression Coefficients show that the individual contributions of six significant predictors; MGO (β = 0.393, p<.01), PAPGO (β = 0.165, p<.01), MA (β = 0.155 p<.01), VLS (β = 0.099, p<.01), and KLS (β = 0.103, p<.01) had significant positive influence on IPS except ALS (-0.100, p<.01) had significant negative influence on IPS in Chemistry for the Total sample. Therefore high MGO, high PAPGO, high MA and high VLS, high KLS and low ALS lead students towards high IPS in Chemistry.
- IPS in Chemistry estimated by using weighted linear combination of significant predictors; MGO, PAPGO, MA, VLS, ALS and KLS; the regression equation developed for Total sample is given by;

$$IPS = 19.603+0.805MGO+0.352PAPGO+0.266MA+0.200VLS-232ALS+0.211KLS$$

Relative Efficiency of Predictor Variables in Predicting the Integrated Process Skills in Chemistry on the basis of Gender.

- MGO is the most potential predictor of Integrated Process Skills in Chemistry for the Male sample. The variance explained by MGO is 21.6%, which is significant (F = 112.78, p<.01).

- PAPGO emerged as the second important predictor of IPS; MGO and PAPGO together explained 25.4% of variance in IPS (F = 69.60, p<.01); of which PAPGO individually contributed 3.8% variance. MA emerged as the third important predictor of IPS. MGO, PAPGO and MA combined explained 27.3% of variance in IPS (F = 50.97, p<.01); of which MA individually contributed 1.9% variance.
- ALS emerged as the fourth important predictor of IPS and MGO, PAPGO, MA, and ALS together explained 28.0% of variance in IPS (F = 39.50, p<.01); of which ALS individually contributed 0.7% of variance.
- KLS emerged as the fifth important predictor of IPS and MGO, PAPGO, MA, ALS and KLS together explained 29.3% of variance in IPS (F = 33.61, p<.01); of which KLS individually contributed 1.3% of variance.
- The remaining 70.7 percent variance in IPS in Chemistry is contributed by variables other than the Predictor Variables selected for the study. Hence the linear combination of five significant Predictor Variables (MGO, PAPGO, MA, ALS & KLS) made a significant influence on IPS in Chemistry.
- The PAVGO and VLS are the predictors excluded and identified as non significant predictors of IPS for Male sample.
- Regression Coefficients show that the individual contributions of five significant predictors MGO (β = 0.456, p<.01), PAPGO (β = 0.159,

p<.01), MA (β = 0.136, p<.01), and KLS (β = 0.120, p<.01) had significant positive influence on IPS except ALS (β = -0.126, p<.01); had significant negative influence on IPS in Chemistry for the Male sample. Therefore high MGO, high PAPGO, high MA and high KLS and low ALS lead students towards high Integrated Process Skills in Chemistry among boys.

- For estimating the IPS in Chemistry by using weighted linear combination of significant predictors; MGO, PAPGO, MA, ALS and KLS; the regression equation developed for Male sample is given by;

  IPS = 38.54+0.957MGO+0.332PAPGO+0.226MA-0.310ALS+ 0.247KLS

- MGO is the most potential predictor of Integrated Process Skills in Chemistry for the Female sample. The variance explained by MGO is13.6% of (F = 88.94, p<.01).

- PAPGO emerged as the second important predictor of IPS; MGO and PAPGO together explained 17.0% of variance in IPS (F = 57.73, p<.01); of which PAPGO individually contributed 3.4% variance. MA emerged as the third important predictor of IPS; MGO, PAPGO and MA combined explained 18.8% of variance in IPS (F = 43.62, p<.01); of which MA individually contributed 1.8% variance.

- VLS emerged as the fourth important predictor of IPS and MGO, PAPGO, MA, and VLS together explained 20.4% of variance in IPS (F = 36.16, p<.01); of which VLS individually contributed 1.6% of variance.

- The remaining 79.6 percent variance in IPS in Chemistry is contributed by variables other than the predictor variables selected for the study. Hence the linear combination of four significant Predictor Variables (MGO, PAPGO, MA, & VLS) made a significant influence on IPS in Chemistry.
- The PAVGO, ALS and KLS are the predictors excluded and identified as non significant predictors of IPS for Female sample.
- Regression coefficients show that the individual contributions of five significant predictors MGO (β= 0.359, p<.01), PAPGO (β=0.168, p<.01), MA (β= 0.192, p<.01), and VLS (β = 0.134, p<.01) has significant positive influence on IPS in Chemistry for the Female sample. Therefore high MGO, high PAPGO, high MA and high VLS lead students towards high IPS in Chemistry among girls.
- For estimating the IPS in Chemistry by using weighted linear combination of significant predictors; MGO, PAPGO, MA, and VLS the regression equation developed for Female sample is given by;

$$IPS = 15.78+0.726MGO+0.366PAPGO+0.335MA+0.269VLS$$

Relative Efficiency of Predictor Variables in Predicting the Integrated Process Skills in Chemistry on the basis of Locale of the Institution.

- MGO is the most potential predictor of Integrated Process Skills in Chemistry for the Urban sample; the variance was explained by MGO is 13.9%, which is significant (F = 75.31, p<.01).

- MA emerged as the second important predictor of IPS. MGO and MA together explained 16.0% of variance in IPS (F = 44.60 p<.01); of which MA individually contributed 2.2% variance.
- PAPGO emerged as the third important predictor of IPS. MGO, MA and PAPGO combined explained 17.6% of variance in IPS (F = 33.27, p<.01); of which PAPGO individually contributed 1.6% variance. After these predictors, VLS emerged as the fourth important predictor of IPS and MGO, MA, PAPGO and VLS together explained 19.7% of variance in IPS (F = 28.51, p<.01); of which VLS individually contributed 2.1% of variance.
- ALS emerged as the fifth important predictor of IPS and MGO, PAPGO, MA, VLS and ALS together explained 20.5% of variance in IPS (F = 23.95, p<.01); of which ALS individually contributed 0.8% of variance.
- KLS emerged as the sixth important predictor of IPS and MGO, PAPGO, MA, VLS, ALS and KLS together explained 21.5% of variance in IPS (F = 21.17, p<.01); of which KLS individually contributed 1.0% of variance.
- The remaining 79.5 percent variance in IPS in Chemistry is contributed by variables other than the predictor variables selected for the stud. Hence the linear combination of six significant predictor variables (MGO, PAPGO, MA, VLS, ALS & KLS) made a significant influence on IPS in Chemistry.
- The PAVGO is the only predictor which is excluded and identified as a non significant predictor of IPS for Urban sample.

- Regression Coefficients show that the individual contributions of six significant predictors; MGO (β = 0.350, p<.01), PAPGO (β = 0.147, p<.01), MA (β = 0.147, p<.01), VLS (β = 0.158, p<.01), and KLS (β = 0.111, p<.01), has significant positive influence on IPS except ALS (β = -0.122, p<.01); has significant negative influence on IPS in Chemistry for the Urban sample. Therefore high MGO, high PAPGO, high MA and high VLS, high KLS and low ALS lead students towards high IPS in Chemistry.

- IPS in Chemistry estimated by using weighted linear combination of significant predictors; MGO, PAPGO, MA, VLS, ALS and KLS, the regression prediction equation developed for Urban sample is given by;

  IPS = 0.69+0.731MGO+0.270MA+0.326PAPGO+0.337VLS-.291ALS+ 0.236KLS

- MGO was the most potential predictor of IPS in Chemistry for the Rural students; the variance explained by MGO is 19.6% which is significant (F = 124.02, p<.01).

- PAPGO emerged as the second important predictor of IPS. MGO and PAPGO together explained 24.4% of variance in IPS (F = 1.96, p<.01); of which PAPGO individually contributed 4.8% variance. MA emerged as the third important predictor of IP; MGO, PAPGO and MA combined explained 27.0% of variance in IPS (F = 62.47, p<.01); of which MA individually contributed 2.6% variance.

- The remaining 73 percent variance in IPS in Chemistry is contributed by variables other than the Predictor Variables selected for the study.

Hence the linear combination of three significant predictor variables (MGO, PAPGO, & MA) made a significant influence on IPS in Chemistry.

- The PAVGO, VLS, ALS and KLS are the predictors excluded and identified as non significant predictors of IPS for Rural sample.
- Regression coefficients show that the individual contributions of five significant predictors MGO (β = 0.438, p<.01), PAPGO (β = 0.164, p<.01), and MA (β = 0.191, p<.01) has significant positive influence on IPS in Chemistry for the Rural sample. Therefore high MGO, high PAPGO, and high MA lead students towards high IPS in Chemistry.
- IPS in Chemistry can be estimated by using weighted linear combination of significant predictors; MGO, PAPGO, and MA, the regression equation developed for Rural sample is given by;

$$IPS = 43.92+0.878MGO+0.292PAPGO+0.393MA$$

Relative Efficiency of Predictor Variables in Predicting the Integrated Process Skills in Chemistry on the basis of Type of Management the Institution.

- MGO was the most potential predictor of Integrated Process Skills in Chemistry for the Government sample, the variance was explained by MGO is 16.3%, which is significant (F = 77.66, p<.01).
- MA emerged as the second important predictor of IPS. MGO and MA combined explained 21.3% of variance in IPS (F = 54.00, p<.01); of which MA individually contributed 5.1% variance.

- The remaining 78.7 percent variance in IPS in Chemistry is contributed by variables other than the Predictor Variables selected for the study. Hence the linear combination of two significant Predictor Variables (MGO & MA) made a significant influence on IPS in Chemistry. The PAPGO, PAVGO, VLS, ALS and KLS are the predictors excluded and identified as non significant predictors of IPS for Government sample.
- Regression Coefficients show that the individual contributions of five significant predictors MGO (β = 0.416, p<.01) and MA (β = 0.225, p<.01), has significant positive influence on IPS in Chemistry for the Government sample. It is therefore concluded that high MGO and high MA lead students towards high IPS in Chemistry.
- For estimating the IPS in Chemistry by using weighted linear combination of significant predictors; MGO and MA, the regression equation developed for Government sample is given by;

$$IPS = 9.514+0.667MGO+0.389MA$$

- MGO is the most potential predictor of Integrated Process Skills in Chemistry for the Aided sample, the variance explained by MGO is 19.6%, which is significant (F = 140.58, p<.01).
- PAPGO emerged as the second important predictor of IPS. MGO and PAPGO together explained 25.8% of variance in IPS (F = 99.96, p<.01); of which PAPGO individually contributed 6.2% variance.

- ALS emerged as the third important predictor of IPS. MGO, PAPGO, and ALS combined explained 26.9% of variance in IPS (F = 70.49, p<.01); of which ALS individually contributed 1.1% variance.
- MA emerged as the fourth important predictor of IPS and MGO, PAPGO, ALS and MA together explained 27.8% of variance in IPS (F = 55.34, p<.01); of which MA individually contributed 0.9% of variance.
- KLS is emerged as the fifth important predictor of IPS and MGO, PAPGO, ALS, MA and KLS together explained 28.6% of variance in IPS (F = 45.84, p<.01); of which KLS individually contributed 0.7% of variance.
- The remaining 71.4 percent variance in Integrated Process Skills in Chemistry is contributed by variables other than the predictor variables selected for the study. Hence the linear combination of six significant Predictor Variables (MGO, PAPGO, ALS, MA & KLS) made a significant influence on IPS in Chemistry.
- The PAVGO and VLS are the predictors which is excluded and identified as non significant predictors of IPS for Aided sample.
- Regression Coefficients show that the individual contributions of six significant predictors; MGO (β = 0.452, p<.01), PAPGO (β = 0.091, p<.01), MA (β = 0.215, p<.01), ALS (β = 0.158, p<.01), and KLS (β = 0.092, p<.01) has significant positive influence on IPS except ALS (β = -0.131, p<.01); has significant negative influence on IPS in Chemistry

for the Urban sample. Therefore high MGO, high PAPGO, high MA and high VLS, high KLS and low ALS lead students towards high IPS in Chemistry.

- IPS in Chemistry can be estimated by using weighted linear combination of significant predictors; MGO, PAPGO, MA, VLS, ALS and KLS, the regression equation developed for Aided sample is given by;

$$IPS = 61.71+1.250MGO+0.155PAPGO+0.467MA-0.297ALS+0.199KLS$$

Tenability of Hypotheses

In this section, the tenability of the hypotheses set for the present normative survey study is examined in the light of the major findings of the study.

The first hypothesis states that *there will be significant difference in the mean scores of Metacognitive Awareness and its levels between the sub samples based on Gender*.

The result of statistical analysis reveals that there exists no significant difference between Male and Female Secondary School Students in their Metacognitive Awareness. In case of the levels of Metacognitive Awareness; there exist a significant difference between Male and Female Secondary School Students in High Metacognitive Awareness level but no significant difference was observed between Male and Female Secondary School Students in moderate and Low Metacognitive Awareness levels. Hence Hypothesis one is partially substantiated.

The second hypothesis states *there will be significant difference in the mean scores of Metacognitive Awareness and its levels between the sub samples based on Locale of the Institution.*

The results of statistical analysis reveals that there is no significant difference between Rural and Urban Secondary School Students in their Metacognitive Awareness and its various levels i.e. High, Moderate and Low Metacognitive Awareness. Hence Hypothesis two is rejected.

The third hypothesis states that *there will be significant difference in the mean scores of Metacognitive Awareness and its levels between the sub samples based on Type of Management of the Institution.*

The results of statistical analysis reveals that there exists no significant difference between Government and Aided Secondary School Students in case of their Metacognitive Awareness and its various levels i.e. High, Moderate and Low Metacognitive Awareness. Hence hypothesis three is rejected.

The fourth hypothesis states *there will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance- Avoidance Goal Orientation between the sub samples based on Gender.*

The Results of statistical analysis reveals that there exists significant difference between Male and Female Secondary School Students in their Performance- Approach Goal Orientation. But no significant difference was observed between Male and Female Secondary School Students in Mastery and Performance- Avoidance Goal Orientations. Hence hypothesis four is partially substantiated.

The fifth hypothesis states *there will be significant difference in the mean scores of Mastery Goal Orientation, Performance- Approach Goal Orientation and Performance- Avoidance Goal Orientation between the sub samples based on Locale of the Institution.*

A result of the analysis reveals that there exists no significant difference between Rural and Urban Secondary School Students in their Mastery, Performance- Approach and Performance- Avoidance Goal Orientations. Hence the fifth hypothesis is rejected.

The sixth hypothesis states *there will be significant difference in the mean scores of Mastery Goal Orientation, Performance-Approach Goal Orientation and Performance- Avoidance Goal Orientation between the sub samples based on Type of Management of the Institution.*

Results of statistical analysis reveals that there exists no significant difference between Government and Aided Secondary School Students in case of their Mastery, Performance-Approach and Performance-Avoidance Goal Orientations. Hence hypothesis six is rejected.

The seventh hypothesis states that *there will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Gender.*

The Results of statistical analysis reveals that there exists significant difference between Male and Female Secondary School Students in their Visual and Auditory Learning Styles but no significant difference was observed between Male and Female Secondary School Students in

Kinaesthetic Learning Style. Hence the seventh hypothesis is substantiated to a great extent.

The eighth hypothesis states that *there will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Locale of the Institution.*

Results of the analysis reveal that there exists no significant difference between Rural and Urban Secondary School Students in case of their Visual, Auditory and Kinaesthetic Learning Styles. Hence hypothesis eight is rejected.

The ninth hypothesis states that *there will be significant difference in the mean scores of Visual Learning Style, Auditory Learning Style and Kinesthetic Learning Style between the sub samples based on Type of Management of the Institution.*

Results of statistical analysis points that there exists significant difference between Government and Aided Secondary School Students in their visual Learning Style but no significant difference was observed in Auditory and Kinaesthetic Learning Styles. Hence hypothesis nine is partially substantiated.

The tenth hypothesis states that *there will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Gender.*

Findings of the study show that there exist significant differences between Male and Female Secondary School Students in their Basic Process Skills in Chemistry. Hence, the tenth hypothesis is not rejected.

The eleventh hypothesis states that *there will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Locale of the Institution.*

The findings of the study show that there is no significant difference between Rural and Urban Secondary School Students in their Basic Process Skills in Chemistry. Hence, the eleventh hypothesis is rejected.

The twelfth hypothesis states that *there will be significant difference in the mean scores of Basic Process Skills in Chemistry between the sub samples based on Type of Management of the Institution.*

The findings of the study show that there is no significant difference between Government and Aided Secondary School Students in their Basic Process Skills in Chemistry. Hence twelfth hypothesis is rejected.

The thirteenth hypothesis states that *there will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Gender.*

The findings of the study show that there is no significant difference between Male and Female Secondary School Students in their Integrated Process Skills in Chemistry. Hence thirteenth hypothesis is rejected.

The fourteenth hypothesis states that *there will be significant difference in the mean scores of Integrated Process Skills in Chemistry between the sub samples based on Locale of the Institution.*

The findings of the study show that there is no significant difference between Rural and Urban Secondary School Students in their Integrated

Process Skills in Chemistry. Hence fourteenth hypothesis is completely rejected.

The fifteenth hypothesis states that *there will be significant difference in the mean scores of Integrated Process Skills in Chemistry for the sub samples based on Type of Management of the Institution.*

The findings of the study show that there is no significant difference between Government and Aided Secondary School Students in their Integrated Process Skills in Chemistry. Hence this hypothesis is rejected.

The sixteenth hypothesis states that *Metacognitive Awareness, Goal Orientation and Learning Styles will be the significant predictors in predicting the Criterion Variable; Basic Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.*

The result of multiple regression analysis shows that Basic Process Skills in Chemistry can be significantly predicted from Metacognitive Awareness, Goal Orientation and Learning Styles for Total and the subsamples based on Gender, Locale and Type of Management of the Institution. Among the predictors, Mastery Goal Orientation is the most significant predictor for all samples; the number of predictors and their sequential order are varied according to Gender, Locale and Type of Management of Institution. Hence sixteenth hypothesis is not rejected.

The seventeenth hypothesis states that *there will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Basic*

Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.

The results of regression analysis reveals that there exist significant multiple correlations between the predictor variables and the Basic Process Skills in Chemistry for Total and subsamples based on Gender, Locale and Type of Management of the Institution. Hence seventeenth hypothesis is not rejected.

The eighteenth hypothesis states that *the relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Basic Process Skills in Chemistry for the Total sample and the subsample based on Gender, Locale and Type of Management of the Institution.*

The result of the study shows that individual and combined contribution of emerged Predictor Variables in predicting Basic Process Skills in Chemistry is significant for Total sample and subsamples based on Gender, Locale and Type of Management of institution. Hence eighteenth hypothesis is not rejected.

The nineteenth hypothesis states that *Metacognitive Awareness, Goal Orientation and Learning Styles will be significant predictors in predicting the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.*

The result of multiple regression analysis shows that the Integrated Process Skills in Chemistry can be significantly predicted from

Metacognitive Awareness, Goal Orientation and Learning Styles. Among the predictors, Mastery Goal Orientation is the most significant predictor; the number of predictors and their sequential order are different for Total and subsamples like Gender, Locale and Type of Management of Institution. Hence nineteenth hypothesis is not rejected.

The twentieth hypothesis states that *there will be significant Multiple Correlation between the Predictor Variables and the Criterion Variable; Integrated Process Skills in Chemistry for the Total sample and the sub samples based on Gender, Locale and Type of Management of the Institution.*

The results of regression analysis reveals that there exist significant multiple correlations between the Predictor Variables and the Basic Process Skills in Chemistry for Total and subsamples like Gender, Locale and Type of Management of the Institution. Hence the hypothesis twentieth is not rejected.

The twenty-first hypothesis states that *the relative efficiency of Predictor Variables (individual and collective contribution) will be significant in predicting the Integrated Process Skills in Chemistry for Total sample and subsample based on Gender, Locale and Type of Management of the Institution.*

The result of the study shows that the individual and combined contribution of emerged predictor variables in predicting basic Process Skills in Chemistry is significant for Total sample and subsamples based on Gender, Locale and Type of Management of institution. Hence twenty-first hypothesis is not rejected.

Conclusions of the Study

Findings of the present study made the investigator to derive the following conclusions.

One of the major conclusions derived from the study is that secondary school students are moderate in their Metacognitive Awareness. Similar results are obtained for the relevant subsamples like Male, Urban and Aided. But Female, Rural and Government students show improvement in this ability than their counterparts. Higher Metacognitive Awareness of Female students reflected that Female students are hard working and they are more concentrated to their metacognitive abilities. The present findings agreed with the study conducted by Satyadev and Yadav (2015) who were identified that students in adolescent stage are having an average level of Metacognitive Awareness and it does not vary across the educational groups. Mareesh and Raju (2015) studied the Metacognitive Awareness of higher secondary students and found that they are average in MA and no variation across the subsamples. Similar results are obtained by Geethanjali (2006); Jaleel and Premachandran (2016).

Another conclusion is that Gender is an important factor and it seems that boys and girls use their metacognitive abilities differently in the learning process. This result is in parallel with the findings of Liliana and Lavinia (2011); Alci and Karatas (2011) and Fitzpatrick (1994); who were identified the significant role of Gender in Metacognitive Awareness. For establishing the insignificant role of Gender, it is corresponding to the findings of studies carried out by Kazu and Ersozlu (2007); Mokhtari and Sheorey (2001); Usha and Noushad (2012).

From the study, Locality of the school is an insignificant factor affecting the Metacognitive Awareness of Secondary School Students. This finding also confirms the conclusion of Shiyamala and Balu (2015); Jaleel, Sajna and Premachandran (2016) and Gopinath (2014) whereas the studies of Noushad and Usha, 2010; Alci and Karatas, 2011 were against the finding.

Type of Management of the Institution does not make difference in Metacognitive Awareness of Secondary School Students. Jaleel, Sajna and Premachandran (2016); Gopinath (2014) explored that the type of management shows no impact upon Metacognitive Awareness but Sofo, Berzins, Colapinto and Ammirato (2009), Sternberg (1997) and Fer (2007) identified difference in metacognition according various factors.

The Metacognitive Awareness of Secondary School Students is linearly related with their Basic Process Skills and Integrated Process Skills. This result agrees with previous research works of Vinitha and Indu (2016), Kosni and Daud (2012); Yong and Fry (2008); and Schraw and Dennison (1994) whose sample also show positive association between metacognitive skills and academic achievement. But in the case of Subsamples Male, Rural and Aided Secondary School Students the Metacognitive Awareness does not show relationship with Basic Process Skills. Therefore it is concluded that metacognition play a decisive role in academic success as improvement in Metacognitive Awareness scores reflected in academic achievement.

Another major conclusion is Metacognitive Awareness can significantly and positively predict Basic and Integrated Process Skills of Secondary School Students in the subject Chemistry. This result points out that high achieving students seem to be aware of more cognitive abilities and cognitive results. Result of the study is received support from the future research findings of Kurtz and Borkowski (1984); Biggs (1985); Stipek (1982); Filho (2010), Chowdary (2013), Kally (2012) identified Metacognitive Awareness as potential predictor academic achievement. The permanent results provide support to the contention that Metacognitive Awareness contributes to the academic success and there by enhances Process Skills.

Most of the Secondary School Students are displaying Performance-Approach goal. In contrary to this Male students at secondary level are favoured to mastery goal when compared to their counterpart. The possible factors for the higher performance Goal Orientation of Female students may be the impact Gender stereotype in motivational pattern of boys and girls emerging out of traditional beliefs, competing nature of girls, more alert about marks/grades and like to demonstrate their abilities before others. But Male students are mainly motivated toward development of their abilities and are not bothered about outperforming others. This finding is confirmed by Chan, Lai and Leung (2002) and they reported that Female students are more performance oriented than Male students. Murcia, Ginueno and Coll (2008) identified that the percentage of mastery Goal Orientation was highest between the age group of 10 to14.

In Performance-Approach Goal Orientation of Secondary School Students Gender makes a difference but in the mastery and Performance-Avoidance goal does Gender has no influence. Hutchins (2009) and Ozkal, Demirtas, Sucuoglu and Guzeller (2014) were reported that Males displayed a stronger mastery Goal Orientation and they are participated in mastery related climate than Females. Urdan and Midgley (2003) also identified Gender difference in motivational pattern. Kucukoglu, Kaya & Turan (2010) identified no significant Gender difference in Performance-Avoidance Goal Orientation.

The present study revealed that three categories of Goal Orientation included in the study were free from the influence of Locale and Type of Management of the Institution. Bulinda, Edwin, Peter (2016) reported no variation in Goal Orientation categories with respect to selected demographic factors such as age, Gender, level and experience. So the present finding is in par with this result.

Secondary School Students show different association between Goal Orientation and Process Skills. The Mastery and Performance-Approach Goal of Secondary School Students is linearly related with their Basic and Integrated Process Skills. Performance-Avoidance Goal Orientation is not related with BPS except for Rural sample they show significant and negative correlation. These findings were in congruence with the conclusions of Chen and Wong (2015); Barzegar (2012) and Hall, Hanna, Hanna, Hall (2015) investigated MGO and PAPGO were positively associated and PVGO is negatively associated. The poor performance associated with PAVGO is confirmed with the studies of Harackiewicz (1997); Archer (1994) and Nolan (1988). Therefore it can be concluded that Goal Orientation is detrimental to better academic performance by encouraging adaptive motivational pattern among students.

Goal Orientation is identified as the most significant predictor since Mastery Goal Orientation was appeared as the strongest and best contributor of Basic and Integrated Process Skills for the Total and subsamples selected for the study. Integrated Process Skills of Government students are not affected by Performance-Approach goal; whereas the removal of Performance-Avoidance Goal is associated with positive effect on Basic and Integrated Process Skills in Chemistry. This may be due to the fact that goal structure in the classroom is related the various incidences such as motivational pattern followed in the classroom, competitive spirit and other personal traits. The present results are in congruence with the earlier works of Harzckiewicz, Barron, Tauer, and Elliot (2002); Alexander, Kulikowich and Jetton (1994); Hidi (1990); Maehr (1976); Sansone and Harackiewicz (1996) emphasised that mastery goals have advantages over other goal and predict the positive outcomes. The result of the study is not in agreement with the idea that multiple-goal endorsement is the most adaptive motivational pattern (Barron and Harackiewicz, 2001). Hence the study can be concluded that both mastery and Performance- Approach goals have independent positive contribution towards academic improvements and thereby beneficial to Process Skills.

The Learning Style preferences of Secondary School Students were found in the order of Visual, Kinaesthetic and Auditory Learning Styles. Each Learning Style has its own positive aspects and drawbacks and the new studies suggest that multiple modes are seen among learners; still they are dominant in the use of either of the sense. So the present study implied that learners are inclined to visual style and it may be due to reason that the current instructional mode in the classroom may provide more opportunities for presenting visual representation of the context in the form of graphs, pictures, handouts, charts, chalk board etc. Learning strategies like role playing, simulation, use of models, debates etc are rarely happens in the classrooms and therefore students has less chance for active participation. Hence the Kinaesthetic mode is naturally hidden among them. This result of Learning Style preferences was in consistent with the study conducted by Baltaci, Yildiz and Ozcakir (2016); Kharb, Samanta, Jindal and Singh, (2007); Wallace (1995) reported that students at the middle stage mostly prefer Visual Learning Style then Kinesthetic Style and finally Auditory Learning Style.

The Learning Style preferences of Secondary School Students differ according to Gender in the case of Visual and Auditory Learning Styles; whereas the Kinesthetic Learning Style is independent of Gender influence. This result of the study is supported by the research conducted by Anjali, Garkal, Yadav, Salwe, Rainer (2016) have reported significant result for variation in Learning Style preferences with respect to Gender; while other studies carried out by Dunn and Griggs (2000); Pyryt, Sandals and Begoray

(1998) indicated that it does not change significantly in accordance with Gender.

There is no significant difference between Rural and Urban Secondary School Students in their Learning Styles. Rajandran-Peresamy, Suryana and Govindan (2009) were investigated that demographic variables like Gender, Locale, place of living and educational level has no significant impact on Learning Styles. However, Anand and Rajendraprasad (2016) and Srivastava (2002) reported the Learning Style preference differs according to locality.

The Visual learners of Government and Aided school differ significantly while Auditory and Kinaesthetic styles were independent of type of the management the school. This finding got evidence from the works carried by Peresamy, Nanna Suryana and Govindan (2009) and Sarabdeen (2013) reported significant influence of Type of Management on Learning Style preferences.

The Visual Learning Styles of Secondary School Students is linearly related with their Basic and Integrated Process Skills, Auditory Learning Style is non-linearly related with their Basic Process Skills and Kinesthetic Learning Style is not related with their Basic Process Skills. But in the case of Subsamples Male, Rural and Aided Secondary School Students Visual Learning Style does not show relationship with Basic Process Skills. The present finding is in parallel with findings of Amalraj & Sreekala (2014); Adam (2006); Brooks (1989) and Gnynkewich (1995); Utanir (2008) show positive association of Visual and Kinaesthetic leaning style preferences and negative association of Auditory style with achievement. Negative association of Learning Style is substantiated by the works of Almigbal (2015) and Farkas (2002). Hence the literature revealed that each style has its own strength and weakness and in most cases a successful learner learns in different ways. However learners with a preferred style can improve significantly over others with no preference.

Learning Styles of Secondary School Students is another important predictor of both Basic and Integrated Process Skills, but the predictive power of Learning Style is differs according to sample. In the case of BPS of Males is not influenced by their Learning Styles; similarly the Integrated Process Skills in Chemistry of Female, Rural, and Government students are free from the influence of their Learning Styles. The studies conducted by Kally (2012); Grasha (1996); Goodwin (1995) are proved the positive impact of Learning Styles on various academic outcomes. Hence this is an obvious indication that Learning Styles make an impact on the students' overall achievement and thereby on Process Skills. Even though a successful learner learns in different way, every student has a certain degree of preferences in each type of Learning Style, and the majority of them have dominance in one or more styles of learning. Therefore, teachers and those who are responsible in planning the curriculum for secondary schools have to bear in mind that students learn in various ways and dimensions (Wratcher, Morrison, Riley & Scheirton, 1997).

The Process Skills in Chemistry of Secondary School Students are low and it is need to be developed. In addition to this, their BPS level is higher compared to IPS and favoured to Female students. The researcher assumed the reason for this is the dominant role of teacher and the teacher centred methods in the classroom inhibits the development of Process Skills. The present study identified Gender is a significant factor influencing the Basic Process Skills and not influencing the Integrated Process Skills. This may because of Male students are more interesting, participating actively and linking life experiences with classroom than Female students who were disciplined and learning oriented. Gender difference in BPS and IPS is reported by Aydogdu, Erkol and Erten (2103) and observed BPS was better than their IPS. Zeidan and Jayosi, 2015; Karar and Yenice (2012); Korucuoglu (2008); Demir (2008) were investigated there is no significant Gender difference in Process Skills. However the studies of Aydinli, Dokme, Unlüa, Ozturk, Demir & Benli (2011); Ates and Behar (2002); Akinbobola and Afolabi (2010) identified significant Gender difference in Process Skills. Hence the present findings were in consistence with existing literature. Findings with respect to locality and type of institution revealed Basic and Integrated Process Skills in Chemistry are free from the influence of these subsamples. This finding confirms the conclusion of Ramnath (2014) but Rao (2008); Raj and Devi (2014) identified the potential influence of locality on SPS; Abungu, Okere & Wachanga (2014) reported the influence of type of institution on SPS. But the present study reveals no influence of management on SPS. The studies of Chebii, Wachanga and Kiboss, 2012 and Abungu, Okere, and Wachanga (2014) signifies the importance of science Process Skills for the attainment of the aims of education, specifically to develop effective critical thinking and competencies like observation, classification, inferences, experimentation, interpretation of data and generalization.

In nut shell the present study concluded the discussion that the study is done based on the platform of review of related literature and their results. The predictor variables and the Criterion variables selected for the study is found significant and they have profound influence on enhancing science Process Skills at secondary level students in the subject Chemistry.

Educational Implications Derived

The main aim of any educational study or research is served only when it is found useful in causing improvements into an existing system or in designing new ones. The present study was undertaken with this intent in view.

Secondary Stage of Education is a crucial period in the process of education and it is the stage when the socialisation and abrupt changes in the developmental process of the child has been taken place. During this period, the support and foundation it provides to children are precious to both individual and society.

The intention behind the present investigation was to study the influence of Metacognitive Awareness, Goal Orientation and Learning Styles on Basic and Integrated Process Skills in Chemistry of Secondary School Students. The scope of the study also included the identification of predictors of Basic and Integrated process Skills and their relative efficiency in predicting Basic and Integrated Process Skills in Chemistry.

The findings of the study reveal that Metacognitive Awareness, Goal Orientation and Learning Style are found to have a significant influence upon Process Skills in Chemistry at Secondary School level. Based results obtained for the study, for enhancing the quality of Science education in general and Chemistry education in particular at Secondary Education Level of the state, the researcher put forth some practical measures which may be helpful for improving the curriculum transaction.

Metacognitive Awareness-Way for Improving Basic and Integrated Process Skills in Chemistry

The findings of the study revealed that Metacognitive Awareness is a significant predictor of Basic and Integrated Process Skills in Chemistry and the percentage of Secondary School Students with high Metacognitive Awareness is low compared to students with Moderate and low Metacognitive Awareness. Hence, the researcher felt that it is fruitful to assess and compare the Metacognitive Awareness and its levels among adolescents belonging to different categories.

When Metacognitive Awareness is developed in the classroom, it will help the students how to perform a task or a set of tasks proceeding through the stages of goal setting, monitoring and evaluation of self. Students who are unaware of their own thinking process are found to be failed in planning, unable to control their performance which ultimately leads them to difficulty in attaining scientific skills. So the investigator support the claim that the level of Metacognitive Awareness should be facilitated among students by adopting strategies which focus on the process rather than the product aspect of learning. Therefore Secondary education should actively promote the inculcation and development of high Metacognitive Awareness among all the students as it would go a long way in improving both the performance and understanding of an individual about his/her own performance.

Even though, Metacognition starts at the early stage of childhood and proceeds through adulthood; this construct lack clarity at the application level. If the curriculum, teachers, and learners are moulded in accordance with the need each person, they become self motivated and self responsible towards learning.

Regulation and Knowledge of cognition is essential for enhancing the critical thinking, task performance and problem solving skills, therefore it is recommended to give extensive practice of these metacognitive skills while teaching and learning science lessons.

Teachers and curriculum framers should be trained to instinctively use promising practices such as metacognitive strategies, inquiry-based methods and other questioning strategies that require students to plan, monitor, and evaluate their ideas during the learning process which improves the acquisition of metacognitive skills.

Metacognitive training is effective for improving the learning and performance outcomes. Therefore, while engaging in a learning task to its objectives, its nature is appropriate with metacognitive strategies. For that, the budding teachers as well as the teachers in service should be sensitized to the need for incorporating metacognitive training in their teaching. Also the curriculum planners and the authorities concerned at DIET, SCERT and NCERT should seriously look into this aspect-the need of the hour, in the teaching learning process.

Goal Orientation – Type of Motivational Pattern Enhances the Process Skills in Chemistry.

The result of the study shows that the Goal Orientation is found to be one of the main non cognitive variables which potentially predict the Basic and Integrated Process Skills in Chemistry of Secondary School Students. Since Goal Orientation of adolescents is related with Process Skills, the teachers can influence their students for early identification and setting of the most appropriate goal.

Most of the researches in achievement motivation suggested that adolescents will be helped to develop an adaptive goal which increases their competence and abilities in challenging situations. Goal Setting Theory states that students with specific goal will do better than students with unspecified goal. From the results of the study, the investigator identified that Mastery Goal Orientation is the predominant predictor and Performance-Approach Orientation is the next significant predictor of Basic and Integrated Process Skills in Chemistry. Hence the educational system, particularly science classrooms, will promote Mastery goals along with Performance-Approach Goal Orientation.

Since the Performance-Avoidance Goal Orientation is not influencing Process Skills, it is the least desirable Goal Orientation which may not be promoted among Secondary School Students. Proper awareness should be disseminated among the stakeholders of education about the relevance of goal setting so that parents, teachers and students would understand the necessity of goals for providing right decisions about their future.

The feedbacks should also be given in an encouraging context and provided with an action plan for their students to make the students judge their progress toward their goals, repair their faults, and direct their efforts toward the success again so that the students‟ motivation can be improved.

The results of the study implied that, If the teachers encourage or praise performance-related activities of students they may think that their intelligence or abilities are fixed and it directs them to avoid challenging tasks and they may lose confidence and motivation when the task becomes hard. Therefore it affects negatively their response to difficult problems. Conversely, giving students praise for process (such as praise for effort or strategy) encourages students to view their intelligence and abilities as malleable, increases their confidence and motivation, and encourages them to seek out

Teachers are the most influential person in the case of a student and the teachers should motivate their students' to have a specified goal, because it is beneficial for their future development, whereas unspecified goal would not promote fully fledged development of a person.

Identification and understanding of the goals of learners with different learning challenges might provide clues on how to improve academic success in Chemistry for these learners, and to avoid high failure rates and drop-outs. Mediating goals with learners could lay the foundation for learners to take accountability and responsibility for their own learning in Chemistry.

Learning Styles - An Important Contributor to Process Skills in Chemistry.

The findings of the study revealed that Basic and Integrated Process Skills in Chemistry of Secondary School Students are related with their Learning Styles to a great extent. Visual and Kinesthetic Learning Styles are positively contributing to Process Skills, whereas the Auditory styles are negatively contributing to the Process Skills.

Since the majority of Secondary School Students choose Visual mode as their preferred style of learning than Auditory and Kinesthetic styles, the science classrooms especially Chemistry classes should provide learning experience including hands-on activities (doing experiments, projects, frequent breaks to allow movement, visual aids, role play, and field trips etc) which promotes the Kinesthetic activities of the learner.

Teachers should adopt different methods, viz; for visual learners, ensure that students can see words written, can use pictures, maps, charts, diagrams, and drawing time lines for events; for auditory learners, tasks like repeating words aloud, small-group discussion, debates, listening to books on tape, oral reports, and oral interpretation can be given. Hence science teachers should consider students' Learning Style preferences and provide differentiated instruction to students.

Researches in the field of Learning Styles show that every style has its own strength and weakness. Some students learn by multiple modes, while others favour one method. Multiple style students are found to be performing better than those with one style (Dunn, Beaudry & Klavas 1989;

Abidin, Rezaee, Abdullah & Singh, 2011). However, identification of Learning Style preferences is very essential in planning the learning environment suitable for effective learning. Further, it is expected that the results of the study would be helpful in organizing guidance and counselling programs for school students in maximizing their overall performance. For Secondary School Students, it is very important to develop their own styles, since each style is suitable and effective for various tasks (Grigorenko & Sternberg, 1997).

If the Learning Style of learners and teaching style of instructors mismatch each other, there occurred a cognitive conflict and it can only be reduced by making flexibility in the usage of styles. For this teachers should consider style differences as they plan how to teach, and make a conscious effort to include various learning styles in their teaching manuals. Therefore teachers who dreamed to be more student centred must establish a link between their teaching styles and students' learning style preferences.

Teachers at secondary level must be free from methodological dogmatism and practice innovative methods for blending the best styles from their own experiences and accommodate learners worth, needs and potentials to remove the perceived mismatch between teaching styles and learning styles.

This study pointed some major implications for curriculum framers that each individual is unique in interest, choices, abilities etc. The teaching techniques in the schools should be undertaken in consonance with the students' style of learning to improve their overall academic performance.

The instructional methods designed by teachers must connect different learning styles using various combinations of experience, reflection, and conceptualization. Instructors can introduce a wide variety of experiential elements into the classroom, such as sound, music, visuals, movement, experience and even talking. Teachers should employ a variety of assessment techniques focussing on the development of whole brain capacity and each of the different learning styles.

Conduct professional development activities and promote classroom research on the use of learning style in improving teaching and student development functions.

Science Process Skills - A Major Output of Science Education.

Acquisition of Science Process Skills is one of the major objectives of science education and these are the fundamental skills upon which the conceptual framework of scientific expertise is built. The study revealed that imparting education by inculcating Process Skills will facilitates the development of the processes that enable students to apply their newly acquired concepts, expand existing concepts, and develop new ones.

While transacting curriculum, it becomes imperative for teachers to engage their students in the process of learning. For this, teachers themselves should have awareness on Science Process Skills; how they can be developed among learners, how a proper learning environment to be organized for the accomplishment of process oriented objectives and so on. Moreover, science teachers should be given in service training in process oriented teaching.

The present study points the importance of periodical assessment of Science Process Skills and the need to reframe the examination system in such a way that it facilitates the assessment of Process Skills. For this, performance based tests have to be conducted occasionally. Effective instructional strategies based on Process Oriented Approach should be developed and used for the enhancement of Science Process Skills.

Chemistry occupies a central position amongst the science subjects and faculties of Chemistry at secondary level need to structure lessons to provide hands on activities with a hope to stimulate students' understanding of science as a process of discovering and acquiring scientific knowledge. When students engage in experiments during Chemistry lessons, they sharpen their Process Skills and can acquire scientific skills which had impact on the overall achievement in Chemistry. Therefore it is the high time to make necessary changes in the Secondary School curriculum for the enhancement of Science Process Skills by considering individual needs and abilities.

Learning Packages developed for improving Science Process Skills by integrating the Metacognitive Process, Motivational theories and Learning Style Preferences, the authorities like NCERT and SCERT can make use of the services of outstanding teachers at the national as well as the state level so that the expertise of the meritorious teachers can be made available even to the students in far flung areas.

Suggestions for Further Research

On the basis of findings and conclusions of the study, the following recommendations are made. Related studies may extend the scope of the present one and further generalization would become possible. Hence the investigator suggests a few research areas in which future researches may be concentrated.

1. Parallel studies can be conducted using other samples such as primary school students and students at Higher Secondary, graduate and post graduate levels.
2. Studies can be conducted to identify other psycho-social and environmental variables which may influence Process Skills in Chemistry.
3. A model of curriculum package and Instructional design following the principles of metacognition and motivation can be developed for secondary level students for improving their Scientific Process Skills.
4. Assessment of Process Skills can be extended to other disciplines such as Languages, Humanities, Commerce etc. thereby its impact on overall academic performance can be understood.
5. Longitudinal studies can be conducted to understand whether Process Skills in Chemistry is accompanied by changes in Metacognitive Awareness, motivational pattern and Learning Styles along the transfer of grades.
6. Development of specific metacognitive interventions could be designed for enhancing Process Skills among Secondary School Students.

7. A detailed analysis can be undertaken to study the effect of Learning Styles coupled with teaching styles on Process Skills in Chemistry.
8. To develop and validate a comprehensive test including paper-pencil items and performance items for assessing the Process Skills across primary to higher education levels.
9. The study can be replicated for understanding the influence of Metacognitive Awareness, Goal Orientation and Learning Styles on other relevant sample such as underachievers, slow learners, gifted learners, learning disabled, sensitive learners, attention- deficit learners and physically challenged learners etc.
10. The present study can be extended by including more number of Process Skills and verify the influence of these predictor variables on each skill.
11. Studies can be conducted to compare Metacognitive Awareness, Goal Orientation and Learning Styles with other significant demographic variables as subsamples.
12. Similar study can be conducted by taking psychological variables like emotional intelligence, mental health and wellbeing etc. as criterion variables to yield some fruitful results.
13. The Effectiveness of Process Oriented Guided Inquiry Learning Strategy can be implemented and its contribution on various academic outcomes can be studied.

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Appendices

Appendix- A1

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

METACOGNITIVE AWARENESS INVENTORY
(Draft)

Dr. A. Hameed	**Meharunnisa Karadan**	**Sabna E.P.**
Assistant Professor	Research Scholar	Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:...

വിദ്യാലയത്തിന്റെ പേര്:... ക്ലാസ്:............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

നിങ്ങളുടെ ചിന്താപ്രവർത്തനങ്ങളെക്കുറിച്ചുള്ള അവബോധം എത്രത്തോള മാണെന്ന് മനസ്സിലാക്കുന്നതിനുള്ള പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയ്ക്കും; 'എല്ലായ്പ്പോഴും', 'ചിലപ്പോൾ മാത്രം', 'ഒരിക്കലുമില്ല' എന്നീ മൂന്നു പ്രതികരണങ്ങൾ കൊടുത്തിട്ടുണ്ട്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളെ സംബന്ധിച്ച് എത്രമാത്രം ശരിയാണെന്ന് രേഖപ്പെടുത്തുക. പ്രതികരണങ്ങൾ രേഖപ്പെടുത്തു മ്പോൾ ക്രമനമ്പർ തെറ്റിപ്പോകാതിരിക്കാൻ പ്രത്യേകം ശ്രദ്ധിക്കുക. നിങ്ങൾ നൽകുന്ന വിവരം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കുന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
1.	എന്റെ കഴിവുകളും പരിമിതികളും എന്തെല്ലാമാണ് എന്ന് എനിക്ക് അറിയാം.			
2.	ഒരു സമയം എനിക്ക് എത്രത്തോളം പഠിക്കാൻ കഴിയും എന്നതിനെകുറിച്ച് ഞാൻ ബോധവാനാണ്.			
3.	ഓരോ വിഷയത്തിലെയും വിവിധ ഭാഗങ്ങൾ എങ്ങിനെ പഠിക്കണം എന്നതിനെ കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
4.	പഠനശേഷം എത്രത്തോളം പഠനം നടന്നു എന്ന് ഞാൻ സ്വയം വിലയിരുത്താറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
5.	പഠനത്തിനാവശ്യവും അനുകൂലവുമായ പഠനസാമഗ്രികളെ കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
6.	ഒരു പുതിയ കാര്യം പഠിക്കുമ്പോൾ അതുമായി ബന്ധപ്പെട്ട് മുമ്പ് പഠിച്ച കാര്യങ്ങൾ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			
7.	പഠനത്തിലേക്ക് എന്നിൽ താത്പര്യം ജനിപ്പിക്കുന്ന ഘടകങ്ങൾ എന്തെല്ലാമാണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			
8.	പഠനസന്ദർഭങ്ങളിൽ ഞാൻ എന്റെ മുന്നറിവുകളെ ഉചിതമായി ഉപയോഗിക്കാറില്ല.			
9.	പഠനത്തിലെ ബുദ്ധിമുട്ടുകൾ മറികടക്കുന്നതിന് ഞാൻ സ്വയം പല മാർഗ്ഗങ്ങൾ അവലംബിക്കാറുണ്ട്.			
10.	വിവിധ വിഷയങ്ങളുടെ പഠനത്തിന് ഏറ്റവും അനുയോജ്യമായ രീതി ഏതാണെന്ന് ഞാൻ കണ്ടെത്താറുണ്ട്.			
11.	പാഠ്യപദ്ധതിയുടെ ഉദ്ദേശ്യങ്ങൾ നേടിയെടുക്കുന്നതിന് വേണ്ടി ലളിതമായ രീതികൾ ഞാൻ സ്വയം സ്വീകരിക്കാറുണ്ട്.			
12.	എന്റെ പഠനശൈലിക്ക് അനുയോജ്യമായ പഠനതന്ത്രം ഏതാണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടില്ല.			
13.	പഠനപ്രശ്നങ്ങൾ പൂർത്തീകരിക്കുന്ന സമയങ്ങളിൽ അതിന്റെ ഫലപ്രാപ്തിയെ കുറിച്ചുള്ള ഉൾക്കാഴ്ച എന്നിൽ ഉണ്ടാകാറില്ല.			
14.	പഠനത്തിൽ എനിക്കുണ്ടാവാറുള്ള നേട്ടങ്ങളിൽ എനിക്ക് സ്വയം ബഹുമാനം തോന്നാറുണ്ട്.			
15.	പഠനഭാരം ലഘൂകരിക്കാൻ പഠനകാര്യത്തിൽ ഞാൻ സമയനിഷ്ഠ പുലർത്താറുണ്ട്.			
16.	പഠനദൗർബല്യങ്ങൾ ലഘൂകരിക്കാൻ എന്റെ കഴിവുകളെ ഞാൻ പരമാവധി ഉപയോഗിക്കാറുണ്ട്.			
17.	ഒരേ രീതിയിലുള്ള പഠനസ്രോതസ്സുകളാണ് എല്ലാ സമയത്തും ഞാൻ പഠനത്തിന് ഉപയോഗിക്കാറുള്ളത്.			
18.	പഠനപ്രവർത്തനസമയത്ത് അതിന്റെ വിവിധ വശങ്ങളിൽ നിന്ന് എനിക്ക് ചിന്തിക്കാൻ സാധിക്കാറില്ല.			
19.	പഠനത്തെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ പരമാവധി നിയന്ത്രിച്ച് ലക്ഷ്യങ്ങൾ നേടിയെടുക്കാൻ ഞാൻ ശ്രമിക്കാറില്ല.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
20.	എന്റെ പഠനരീതി പഠനഫലം ഉണ്ടാക്കുന്നതിന് അനുയോജ്യമാണോ എന്ന് ഞാൻ സ്വയം വിലയിരുത്താറില്ല.			
21.	സാഹചര്യങ്ങൾക്കനുസരിച്ച് പഠനരീതികളിൽ ഞാൻ സ്വയം മാറ്റങ്ങൾ നടത്താറുണ്ട്.			
22.	പഠനപ്രവർത്തനങ്ങൾ മെച്ചപ്പെടുത്തുന്നതിനാവശ്യമായ നൂതന മാർഗ്ഗങ്ങളെ പറ്റി ഞാൻ ചിന്തിക്കാറില്ല.			
23.	പഠന തന്ത്രത്തിന്റെ ഊന്നൽ അനുസരിച്ച് അത് ഏത് സന്ദർഭത്തിൽ ഉപയോഗിക്കണം എന്ന് എനിക്കറിയാം.			
24.	വിജയത്തിലേക്ക് നയിക്കുന്ന പഠനരീതികൾ ഏതാണെന്ന് ഞാൻ കണ്ടെത്താറില്ല.			
25.	പാഠ്യവിഷയങ്ങളെ അവയുടെ പ്രാധാന്യത്തിനനുസരിച്ച് ഞാൻ തരം തിരിക്കാറുണ്ട്.			
26.	എനിക്ക് അനുവദിച്ചിട്ടുള്ള സമയത്തിനനുസരിച്ച് പാഠഭാഗങ്ങളെ മുൻകൂട്ടി വേർതിരിക്കാറില്ല.			
27.	വ്യക്തമായ ആസൂത്രണത്തോട് കൂടിയല്ലാതെ ഞാൻ പഠിക്കാൻ ഇരിക്കാറില്ല.			
28.	നിയമങ്ങളും നിർദ്ദേശങ്ങളും വായിച്ചതിന് ശേഷം മാത്രമാണ് ഞാൻ പ്രശ്നങ്ങൾ നിർദ്ധാരണം ചെയ്യാറുള്ളത്.			
29.	എന്താണ് പഠിക്കുന്നത് എന്നതിന്റെ പ്രാധാന്യത്തെക്കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
30.	പഠനലക്ഷ്യങ്ങളുടെയും പഠനോദ്ദേശ്യങ്ങളുടെയും ഉള്ളടക്കം ഞാൻ ഘടനാപരമായി മൂല്യനിർണ്ണയം നടത്താറുണ്ട്.			
31.	എന്റെ പഠനത്തിൽ വരുന്ന പോരായ്മകൾ മനസ്സിലാക്കാൻ ലഭ്യമായ എല്ലാ അവസരങ്ങളും ഞാൻ ഉപയോഗപ്പെടുത്താറുണ്ട്.			
32.	പഠനാസൂത്രണം മെച്ചപ്പെടുത്തുവാനാവശ്യമായ കാര്യങ്ങളെപറ്റി ഞാൻ എന്നോട് തന്നെ ചോദിക്കാറുണ്ട്.			
33.	പഠനഫലമായി എന്റെ കഴിവുകളിലും ചിന്തകളിലും എന്തെങ്കിലും മാറ്റങ്ങൾ ഉണ്ടായോ എന്ന് ഞാൻ നീരിക്ഷിക്കാറില്ല.			
34.	പരീക്ഷകൾ, ചോദ്യങ്ങൾ എന്നിവയേക്കാൾ ഞാൻ പ്രാധാന്യം കല്പിക്കുന്നത് ആത്മവിശകലനത്തിനാണ്.			
35.	വിജയത്തിലേക്ക് എളുപ്പത്തിൽ എത്തിച്ചേരുന്നതിനുള്ള കുറുക്കുവഴികൾ ഞാൻ അന്വേഷിക്കാറില്ല.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
36.	എന്റെ ചിന്തകളെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ ഏതൊക്കെയാണ് എന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			
37.	പഠനത്തിലെ എന്റെ ശ്രദ്ധയെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ ഏതെല്ലാമാണെന്ന് ഞാൻ തിരിച്ചറിഞ്ഞിട്ടുണ്ട്.			
38.	ഓരോ പാഠഭാഗങ്ങൾ കഴിഞ്ഞതിനു ശേഷവും ഞാൻ ചെറിയ ടെസ്റ്റുകളിലൂടെ എന്റെ പഠനത്തെ വിലയിരുത്താറുണ്ട്			
39.	പഠനതന്ത്രങ്ങളും പഠനഫലങ്ങളും തമ്മിലുള്ള ബന്ധം കണ്ടെത്താൻ എനിക്ക് സാധിക്കാറില്ല.			
40.	പ്രശ്നപരിഹാര ഘട്ടങ്ങളിൽ ആവശ്യമായ കാര്യങ്ങൾ ഞാൻ മനഃപൂർവ്വം എന്റെ ഓർമ്മയിൽ നിന്നും ചികഞ്ഞെടുക്കാറുണ്ട്.			
41.	എന്റെ വികാരങ്ങളെയും ചിന്തകളെയും പഠനത്തിൽ നിന്നും മാറ്റിനിർത്തുന്നതിന് ഞാൻ ശ്രമിക്കാറുണ്ട്.			
42.	പഠനത്തിൽ താത്പര്യം നിലനിർത്തുന്ന ഘടകങ്ങൾ ഏതെല്ലാമാണെന്ന് എനിക്ക് മനസ്സിലാക്കാൻ സാധിച്ചിട്ടില്ല.			
43.	പഠനലക്ഷ്യത്തിന്റെ പൂർത്തീകരണത്തിനാവശ്യമായ ആശയങ്ങളെപറ്റി എനിക്ക് ധാരണയുണ്ട്.			
44.	ഒരു പുതിയ കാര്യം പഠിക്കുന്നതിന്റെ ആവശ്യകതയെപറ്റി എനിക്ക് ധാരണയുണ്ട്.			
45.	പഠനസമയത്ത് രൂപീകരിക്കേണ്ട പ്രധാനപ്പെട്ട ആശയങ്ങളെ കുറിച്ച് എന്നിൽ ധാരണയുണ്ടാകാറില്ല.			
46.	ക്ലാസിൽ വ്യക്തമാകാത്ത ആശയങ്ങൾ കൂട്ടുകാരുമായി ചർച്ചചെയ്ത് ഞാൻ ആശയവ്യക്തത വരുത്താറുണ്ട്.			
47.	ടെലിവിഷനിലൂടെയും ഇന്റർനെറ്റിലൂടെയും എന്റെ പഠന പ്രവർത്തനം മെച്ചപ്പെടുത്തുന്നതിനാവശ്യമായ കാര്യങ്ങൾ ഞാൻ സ്വയം കണ്ടെത്താറുണ്ട്.			
48.	പഠനപ്രവർത്തനം വിജയകരമായി പൂർത്തീകരിക്കാൻ സ്വയം കഴിയുമോ എന്ന ചിന്ത എന്നെ പലപ്പോഴും അലട്ടാറില്ല.			
49.	അധ്യാപകർ നടത്തുന്ന മൂല്യനിർണ്ണയത്തിന്റെ അടിസ്ഥാനത്തിൽ ക്ലാസിലെ എന്റെ നിലവാരം എന്താണെന്ന് ഞാൻ മനസ്സിലാക്കാറുണ്ട്.			
50.	വ്യത്യസ്തമായ പഠനസാമഗ്രികൾ ഉപയോഗിച്ച് പഠിക്കുന്നതാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
51.	പഠനതന്ത്രങ്ങളുടെ ഉപയോഗം, അവയുടെ ലഭ്യത എന്നിവയെ കുറിച്ച് ഞാൻ സ്വയം ചിന്തിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
52.	ക്ലാസിൽ പഠിപ്പിക്കുന്ന ഭാഗങ്ങൾ വ്യക്തമായി മനസ്സിലായി ട്ടുണ്ടോ എന്ന് പരിശോധിക്കുന്നതിനായി ഞാൻ സ്വയം ചോദ്യങ്ങൾ ചോദിക്കാറുണ്ട്.			
53.	പഠിക്കുമ്പോൾ പ്രധാനപ്പെട്ട ആശയങ്ങൾ സംയോജിപ്പിച്ച് മുന്നോട്ടു പോകുവാൻ ശ്രമിക്കാറില്ല.			
54.	പാഠഭാഗങ്ങളിൽ നിന്നും വരാൻ സാധ്യതയുള്ള ചോദ്യങ്ങൾ ഞാൻ മുൻകൂട്ടി തയ്യാറാക്കാറില്ല.			
55.	പാഠഭാഗങ്ങളെ ആസ്പദമാക്കി, സ്വന്തമായി പുതിയ ആശയ ങ്ങൾ വികസിപ്പിക്കാൻ ശ്രദ്ധിക്കാറുണ്ട്.			
56.	ക്ലാസിൽ ഒരു പുതിയ സിദ്ധാന്തമോ, വ്യാഖ്യാനമോ, അവത രിപ്പിക്കുമ്പോൾ അവയുടെ ഉത്ഭവത്തെകുറിച്ച് ഞാൻ ചിന്തി ക്കാറില്ല.			
57.	അധ്യാപകവിവരണങ്ങൾ എഴുതിയെടുക്കുവാൻ പ്രയാസം തോന്നിയാൽ പിന്നീട് സ്വന്തം പഠനക്കുറിപ്പുകൾ ഞാൻ തയ്യാറാക്കാറുണ്ട്.			
58.	ഒരു പഠനഭാഗം പഠിക്കുന്നതിന് മുമ്പ് അത് എപ്രകാരമാണ് തയ്യാറാക്കിയിരിക്കുന്നത് എന്ന് ശ്രദ്ധിക്കാറില്ല.			
59.	ഏതെങ്കിലും നൂതന പാഠഭാഗങ്ങളിൽ ആശയക്കുഴപ്പം അനുഭവപ്പെട്ടാൽ മുമ്പ് പഠിച്ചതുമായി ബന്ധപ്പെടുത്തി ആശയങ്ങൾ വ്യക്തമാക്കാൻ ശ്രമിക്കാറുണ്ട്.			
60.	പഠനത്തിന്റെ ഓരോ ഘട്ടവും ശരിയായ രീതിയിൽ അവലോ കനം ചെയ്ത് മുന്നോട്ട് പോകാൻ എനിക്ക് സാധിക്കാറില്ല.			
61.	പഠനഭാഗവുമായി ബന്ധപ്പെട്ട നിഗമനങ്ങൾ വായിക്കുകയോ കേൾക്കുകയോ ചെയ്യുമ്പോൾ സാധ്യതയുള്ള മറ്റു നിഗമന ങ്ങളെകുറിച്ച് ഞാൻ ചിന്തിക്കാറുണ്ട്.			
62.	പഠനത്തിലൂടെ എത്തിച്ചേരാൻ ആഗ്രഹിക്കുന്ന ലക്ഷ്യം ഞാൻ മൂൻകൂട്ടി നിശ്ചയിച്ചിട്ടില്ല.			
63.	അധ്യാപകർ ഉപയോഗിക്കുന്ന പഠനസാമഗ്രികളേക്കാൾ അനുയോജ്യമായ സാമഗ്രികൾ ഏതാണെന്ന് ഞാൻ അന്വേഷിച്ച് കണ്ടെത്താറുണ്ട്.			
64.	പാഠപുസ്തകങ്ങളിലെ പാഠ്യപ്രശ്നങ്ങൾ നിർദ്ദാരണം ചെയ്യു ന്നതിന് ഒന്നിൽ കൂടുതൽ പഠനതന്ത്രങ്ങൾ ഞാൻ സ്വയം അവലംബിക്കാറുണ്ട്.			
65.	പഠനരീതിയും പഠനലക്ഷ്യങ്ങളും പരസ്പരം ചേർന്ന് പോകുന്നുണ്ടോ എന്ന് ഞാൻ വിശകലനം നടത്താറില്ല.			
66.	പഠനത്തിന്റെ പൊതുലക്ഷ്യം നേടുന്നതിൽ തന്റെ വ്യക്തി പരമായ ചുമതല എന്താണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			

Appendix- A2

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

METACOGNITIVE AWARENESS INVENTORY
(Draft)

Dr. A. Hameed	**Meharunnisa Karadan**	**Sabna E.P.**
Assistant Professor	Research Scholar	Research Scholar

Name of the Student:..

Name of the School:.. Class:............

Male/Female:... Govt./Aided/Unaided

Instructions:

The statements given below are to test how far you are aware of your own thinking process. For each statement three responses - “Always”, “Sometimes” and “Never” are given. After reading each statement carefully mark (✓) which suits the best in your case. Take special care to keep serial number while answering. Your data will be confidential and used only for research purposes. Please ensure you are responded to all the statements.

Sl. No.	Statements	Always	Sometimes	Never
1.	I know what are my strengths and weaknesses			
2.	I am aware of how much I can learn at a stretch			
3.	I am not bothered about the method of learning different areas of a particular subject.			
4.	I used to evaluate how much I learned after learning section of a subject.			
5.	I don’t think of suitable and necessary learning materials.			
6.	I am able to apply already learned things while studying new materials.			

Sl. No.	Statements	Always	Sometimes	Never
7.	I am aware of the various elements which creates interest in learning.			
8.	I don't make use of previous knowledge suitably during learning situations.			
9.	I find my own ways to overcome hurdles of learning.			
10.	I used to find out most suitable methods to learn different subjects.			
11.	I follow my own simple ways to attain curricular objectives.			
12.	I didn't identify learning strategies suitable for my learning style.			
13.	While solving learning problems I don't have insight in to its outcomes.			
14.	I used to feel proud of my achievements in learning.			
15.	In order to simplify learning task I keep punctuality.			
16.	In order to simplify my weaknesses in learning I make use of my strengths to the maximum			
17.	I always use similar resources for learning.			
18.	While doing learning activities I am not able to consider it from various angles.			
19.	I don't try to achieve my objectives by controlling different elements that affect learning.			
20.	I do not check whether my learning style is suitable for learning achievement.			
21.	I modify my learning style according to situations.			
22.	I do not think of novel strategies to enrich learning activities.			
23.	I know when and were to use a particular learning strategy on the basis of its effectiveness.			
24.	I don't identify which learning style lead to success.			
25.	I classify different subjects based on their importance.			

Sl. No.	Statements	Always	Sometimes	Never
26.	I do not categorize lessons in advance based on the time allotted.			
27.	I do not study without proper planning.			
28.	I do not solve problems before reading instructions and regulations.			
29.	I do not think of the importance of what is being learned.			
30.	I structurally analyze the aims and objectives of learning.			
31.	I utilize all the available occasions to evaluate my demerits in learning.			
32.	I ask myself for the ways to improve planning of the learning.			
33.	I do not observe whether there is any change in my skills and thoughts as a result of learning.			
34.	I prefer self analysis to tests and questions.			
35.	I don't search for short-cut methods leading to success.			
36.	I am aware of the factors that affects my thoughts.			
37.	I have identified the factors that influence my attention in learning.			
38.	After each lesson I used to evaluate myself using simple tests.			
39.	I cannot relate learning strategies with learning outcomes.			
40.	In problem solving stage I recall purposefully what is needed.			
41.	I try to keep away my feelings and emotions from learning.			
42.	I can understand factors that create interest in learning.			
43.	I am aware of what concepts I have to attain for realizing the aims of learning.			

Sl. No.	Statements	Always	Sometimes	Never
44.	I know the importance of learning new concepts.			
45.	I do not realized what are the major concepts to be attained during learning process.			
46.	I discuss with my friends the concepts which are not clear in the class.			
47.	I try to find out myself ways and methods to enhance my learning through television and internet.			
48.	It does not bother me whether I could complete the learning process myself successfully.			
49.	I used to identify my positions in the class based on teacher evaluation.			
50.	I like learning with help of various learning aids.			
51.	I think myself the use and availability of learning strategies.			
52.	I usually ask questions to myself to analyze how far I am, clear about the areas taught in the class.			
53.	While learning I do not try to integrate major concepts.			
54.	I do not prepare the possible questions from lessons in advance.			
55.	I try to form new concepts based on the lessons.			
56.	When new theories and definitions are introduced in the class I do not think its origin.			
57.	If I find difficulty to take down lecture notes, I prepare my own notes.			
58.	Before trying to learn an area of lesson I don’t usually consider how it is prepared.			
59.	When I find any new lesson confusing I try to associate it to the lessons learned earlier for getting conceptual clarity.			
60.	I could not review each stages of learning in proper way before proceeding to the next level.			

Sl. No.	Statements	Always	Sometimes	Never
61.	When I read or listen conclusions of lessons, I used to think of other possibilities.			
62.	I do not set the goals of learning in advance.			
63.	I used find out materials more suitable than those are used by teachers.			
64.	I used to relay on multiple strategies to analyse problems in the text books.			
65.	I do not analyse whether the learning styles go hand in hand with learning objectives.			
66.	I am aware of my personal responsibility in achieving general aims of learning.			

Appendix- A3

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

METACOGNITIVE AWARENESS INVENTORY
(Final)

Dr. A. Hameed Assistant Professor | **Meharunnisa Karadan** Research Scholar | **Sabna E.P.** Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:..

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:.............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

നിങ്ങളുടെ ചിന്താപ്രവർത്തനങ്ങളെക്കുറിച്ചുള്ള അവബോധം എത്രത്തോള മാണെന്ന് മനസ്സിലാക്കുന്നതിനുള്ള പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയ്ക്കും; 'എല്ലായ്പ്പോഴും', 'ചിലപ്പോൾ മാത്രം', 'ഒരിക്കലുമില്ല' എന്നീ മൂന്നു പ്രതികരണങ്ങൾ കൊടുത്തിട്ടുണ്ട്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ പറയുന്ന കാര്യങ്ങൾ നിങ്ങളെ സംബന്ധിച്ച് എത്രമാത്രം ശരിയാണെന്ന് രേഖപ്പെടുത്തുക. പ്രതികരണങ്ങൾ രേഖപ്പെടുത്തുമ്പോൾ ക്രമനമ്പർ തെറ്റിപ്പോകാതിരിക്കാൻ പ്രത്യേകം ശ്രദ്ധിക്കുക. നിങ്ങൾ നൽകുന്ന വിവരം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കു ന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
1.	എന്റെ കഴിവുകളും പരിമിതികളും എന്തെല്ലാമാണ് എന്ന് എനിക്ക് അറിയാം.			
2.	ഓരോ വിഷയത്തിലെയും വിവിധ ഭാഗങ്ങൾ എങ്ങിനെ പഠിക്കണം എന്നതിനെ കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
3.	പഠനശേഷം എത്രത്തോളം പഠനം നടന്നു എന്ന് ഞാൻ സ്വയം വിലയിരുത്താറുണ്ട്.			
4.	പഠനത്തിനാവശ്യവും അനുകൂലവുമായ പഠനസാമഗ്രികളെ കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
5.	ഒരു പുതിയ കാര്യം പഠിക്കുമ്പോൾ അതുമായി ബന്ധപ്പെട്ട് മുമ്പ് പഠിച്ച കാര്യങ്ങൾ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
6.	പഠനത്തിലേക്ക് എന്നിൽ താത്പര്യം ജനിപ്പിക്കുന്ന ഘടകങ്ങൾ എന്തെല്ലാമാണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			
7.	പഠനത്തിലെ ബുദ്ധിമുട്ടുകൾ മറികടക്കുന്നതിന് ഞാൻ സ്വയം പല മാർഗ്ഗങ്ങൾ അവലംബിക്കാറുണ്ട്.			
8.	വിവിധ വിഷയങ്ങളുടെ പഠനത്തിന് ഏറ്റവും അനുയോജ്യമായ രീതി ഏതാണെന്ന് ഞാൻ കണ്ടെത്താറുണ്ട്.			
9.	പാഠ്യപദ്ധതിയുടെ ഉദ്ദേശ്യങ്ങൾ നേടിയെടുക്കുന്നതിന് വേണ്ടി ലളിതമായ രീതികൾ ഞാൻ സ്വയം സ്വീകരിക്കാറുണ്ട്.			
10.	എന്റെ പഠനശൈലിക്ക് അനുയോജ്യമായ പഠനതന്ത്രം ഏതാണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടില്ല.			
11.	പഠനപ്രശ്നങ്ങൾ പൂർത്തീകരിക്കുന്ന സമയങ്ങളിൽ അതിന്റെ ഫലപ്രാപ്തിയെ കുറിച്ചുള്ള ഉൾക്കാഴ്ച എന്നിൽ ഉണ്ടാകാറില്ല.			
12.	പഠനത്തിൽ എനിക്കുണ്ടാവാറുള്ള നേട്ടങ്ങളിൽ എനിക്ക് സ്വയം ബഹുമാനം തോന്നാറുണ്ട്.			
13.	പഠനഭാരം ലഘൂകരിക്കാൻ പഠനകാര്യത്തിൽ ഞാൻ സമയനിഷ്ഠ പുലർത്താറുണ്ട്.			
14.	പഠനദൗർബല്യങ്ങൾ ലഘൂകരിക്കാൻ എന്റെ കഴിവുകളെ ഞാൻ പരമാവധി ഉപയോഗിക്കാറുണ്ട്.			
15.	പഠനപ്രവർത്തനസമയത്ത് അതിന്റെ വിവിധ വശങ്ങളിൽ നിന്ന് എനിക്ക് ചിന്തിക്കാൻ സാധിക്കാറില്ല.			
16.	പഠനത്തെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ പരമാവധി നിയന്ത്രിച്ച് ലക്ഷ്യങ്ങൾ നേടിയെടുക്കാൻ ഞാൻ ശ്രമിക്കാറില്ല.			
17.	സാഹചര്യങ്ങൾക്കനുസരിച്ച് പഠനരീതികളിൽ ഞാൻ സ്വയം മാറ്റങ്ങൾ നടത്താറുണ്ട്.			
18.	പഠനപ്രവർത്തനങ്ങൾ മെച്ചപ്പെടുത്തുന്നതിനാവശ്യമായ നൂതന മാർഗ്ഗങ്ങളെ പറ്റി ഞാൻ ചിന്തിക്കാറില്ല.			
19.	പഠന തന്ത്രത്തിന്റെ ഊന്നൽ അനുസരിച്ച് അത് ഏത് സന്ദർഭത്തിൽ ഉപയോഗിക്കണം എന്ന് എനിക്കറിയാം.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
20.	വിജയത്തിലേക്ക് നയിക്കുന്ന പഠനരീതികൾ ഏതാണെന്ന് ഞാൻ കണ്ടെത്താറില്ല.			
21.	പാഠ്യവിഷയങ്ങളെ അവയുടെ പ്രാധാന്യത്തിനനുസരിച്ച് ഞാൻ തരം തിരിക്കാറുണ്ട്.			
22.	എനിക്ക് അനുവദിച്ചിട്ടുള്ള സമയത്തിനനുസരിച്ച് പാഠഭാഗങ്ങളെ മുൻകൂട്ടി വേർതിരിക്കാറില്ല.			
23.	നിയമങ്ങളും നിർദ്ദേശങ്ങളും വായിച്ചതിന് ശേഷം മാത്രമാണ് ഞാൻ പ്രശ്നങ്ങൾ നിർദ്ധാരണം ചെയ്യാറുള്ളത്.			
24.	എന്താണ് പഠിക്കുന്നത് എന്നതിന്റെ പ്രാധാന്യത്തെക്കുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
25.	പഠനലക്ഷ്യങ്ങളുടെയും പഠനോദ്ദേശ്യങ്ങളുടെയും ഉള്ളടക്കം ഞാൻ ഘടനാപരമായി മൂല്യനിർണ്ണയം നടത്താറുണ്ട്.			
26.	എന്റെ പഠനത്തിൽ വരുന്ന പോരായ്മകൾ മനസ്സിലാക്കാൻ ലഭ്യമായ എല്ലാ അവസരങ്ങളും ഞാൻ ഉപയോഗപ്പെടുത്താറുണ്ട്.			
27.	പഠനാസൂത്രണം മെച്ചപ്പെടുത്തുവാനാവശ്യമായ കാര്യങ്ങളെ പറ്റി ഞാൻ എന്നോട് തന്നെ ചോദിക്കാറുണ്ട്.			
28.	പഠനഫലമായി എന്റെ കഴിവുകളിലും ചിന്തകളിലും എന്തെങ്കിലും മാറ്റങ്ങൾ ഉണ്ടായോ എന്ന് ഞാൻ നീരിക്ഷിക്കാറില്ല.			
29.	പരീക്ഷകൾ, ചോദ്യങ്ങൾ എന്നിവയേക്കാൾ ഞാൻ പ്രാധാന്യം കല്പിക്കുന്നത് ആത്മവിശകലനത്തിനാണ്.			
30.	എന്റെ ചിന്തകളെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ ഏതൊക്കെയാണ് എന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			
31.	പഠനത്തിലെ എന്റെ ശ്രദ്ധയെ സ്വാധീനിക്കുന്ന ഘടകങ്ങൾ ഏതെല്ലാമാണെന്ന് ഞാൻ തിരിച്ചറിഞ്ഞിട്ടുണ്ട്.			
32.	ഓരോ പാഠഭാഗങ്ങൾ കഴിഞ്ഞതിനു ശേഷവും ഞാൻ ചെറിയ ടെസ്റ്റുകളിലൂടെ എന്റെ പഠനത്തെ വിലയിരുത്താറുണ്ട്			
33.	എന്റെ വികാരങ്ങളെയും ചിന്തകളെയും പഠനത്തിൽ നിന്നും മാറ്റിനിർത്തുന്നതിന് ഞാൻ ശ്രമിക്കാറുണ്ട്.			
34.	പഠനത്തിൽ താത്പര്യം നിലനിർത്തുന്ന ഘടകങ്ങൾ ഏതെല്ലാമാണെന്ന് എനിക്ക് മനസ്സിലാക്കാൻ സാധിച്ചിട്ടില്ല.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
35.	ഒരു പുതിയ കാര്യം പഠിക്കുന്നതിന്റെ ആവശ്യകതയെപറ്റി എനിക്ക് ധാരണയുണ്ട്.			
36.	പഠനസമയത്ത് രൂപീകരിക്കേണ്ട പ്രധാനപ്പെട്ട ആശയങ്ങളെ കുറിച്ച് എന്നിൽ ധാരണയുണ്ടാകാറില്ല.			
37.	ക്ലാസിൽ വ്യക്തമാകാത്ത ആശയങ്ങൾ കൂട്ടുകാരുമായി ചർച്ചചെയ്ത് ഞാൻ ആശയവ്യക്തത വരുത്താറുണ്ട്.			
38.	ടെലിവിഷനിലൂടെയും ഇന്റർനെറ്റിലൂടെയും എന്റെ പഠനപ്രവർത്തനം മെച്ചപ്പെടുത്തുന്നതിനാവശ്യമായ കാര്യങ്ങൾ ഞാൻ സ്വയം കണ്ടെത്താറുണ്ട്.			
39.	അധ്യാപകർ നടത്തുന്ന മൂല്യനിർണ്ണയത്തിന്റെ അടിസ്ഥാനത്തിൽ ക്ലാസിലെ എന്റെ നിലവാരം എന്താണെന്ന് ഞാൻ മനസ്സിലാക്കാറുണ്ട്.			
40.	വ്യത്യസ്തമായ പഠനസാമഗ്രികൾ ഉപയോഗിച്ച് പഠിക്കുന്നതാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
41.	പഠനതന്ത്രങ്ങളുടെ ഉപയോഗം, അവയുടെ ലഭ്യത എന്നിവയെകുറിച്ച് ഞാൻ സ്വയം ചിന്തിക്കാറുണ്ട്.			
42.	പഠിക്കുമ്പോൾ പ്രധാനപ്പെട്ട ആശയങ്ങൾ സംയോജിപ്പിച്ച് മുന്നോട്ടു പോകുവാൻ ശ്രമിക്കാറില്ല.			
43.	പാഠഭാഗങ്ങളിൽ നിന്നും വരാൻ സാധ്യതയുള്ള ചോദ്യങ്ങൾ ഞാൻ മുൻകൂട്ടി തയ്യാറാക്കാറില്ല.			
44.	പാഠഭാഗങ്ങളെ ആസ്പദമാക്കി, സ്വന്തമായി പുതിയ ആശയങ്ങൾ വികസിപ്പിക്കാൻ ശ്രദ്ധിക്കാറുണ്ട്.			
45.	ക്ലാസിൽ ഒരു പുതിയ സിദ്ധാന്തമോ, വ്യാഖ്യാനമോ, അവതരിപ്പിക്കുമ്പോൾ അവയുടെ ഉത്ഭവത്തെകുറിച്ച് ഞാൻ ചിന്തിക്കാറില്ല.			
46.	അധ്യാപകവിവരണങ്ങൾ എഴുതിയെടുക്കുവാൻ പ്രയാസം തോന്നിയാൽ പിന്നീട് സ്വന്തം പഠനക്കുറിപ്പുകൾ ഞാൻ തയ്യാറാക്കാറുണ്ട്.			
47.	ഒരു പഠനഭാഗം പഠിക്കുന്നതിന് മുമ്പ് അത് എപ്രകാരമാണ് തയ്യാറാക്കിയിരിക്കുന്നത് എന്ന് ശ്രദ്ധിക്കാറില്ല.			
48.	ഏതെങ്കിലും നൂതന പാഠഭാഗങ്ങളിൽ ആശയക്കുഴപ്പം അനുഭവപ്പെട്ടാൽ മുമ്പ് പഠിച്ചതുമായി ബന്ധപ്പെടുത്തി ആശയങ്ങൾ വ്യക്തമാക്കാൻ ശ്രമിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
49.	പഠനഭാഗവുമായി ബന്ധപ്പെട്ട നിഗമനങ്ങൾ വായിക്കുകയോ കേൾക്കുകയോ ചെയ്യുമ്പോൾ സാധ്യതയുള്ള മറ്റു നിഗമനങ്ങളെകുറിച്ച് ഞാൻ ചിന്തിക്കാറുണ്ട്.			
50.	അധ്യാപകർ ഉപയോഗിക്കുന്ന പഠനസാമഗ്രികളേക്കാൾ അനുയോജ്യമായ സാമഗ്രികൾ ഏതാണെന്ന് ഞാൻ അന്വേഷിച്ച് കണ്ടെത്താറുണ്ട്.			
51.	പാഠപുസ്തകങ്ങളിലെ പാഠ്യപ്രശ്നങ്ങൾ നിർദ്ധാരണം ചെയ്യുന്നതിന് ഒന്നിൽ കൂടുതൽ പഠനതന്ത്രങ്ങൾ ഞാൻ സ്വയം അവലംബിക്കാറുണ്ട്.			
52.	പഠനരീതിയും പഠനലക്ഷ്യങ്ങളും പരസ്പരം ചേർന്ന് പോകുന്നുണ്ടോ എന്ന് ഞാൻ വിശകലനം നടത്താറില്ല.			
53.	പഠനത്തിന്റെ പൊതുലക്ഷ്യം നേടുന്നതിൽ തന്റെ വ്യക്തിപരമായ ചുമതല എന്താണെന്ന് ഞാൻ മനസ്സിലാക്കിയിട്ടുണ്ട്.			

Appendix- A4

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

METACOGNITIVE AWARENESS INVENTORY
(Final)

Dr. A. Hameed	**Meharunnisa Karadan**	**Sabna E.P.**
Assistant Professor	Research Scholar	Research Scholar

Name of the Student:...

Name of the School:.. Class:............

Male/Female:... Govt./Aided/Unaided

Instructions:

The statements given below are to test how far you are aware of your own thinking process. For each statement three responses - "Always", "Sometimes" and "Never" are given. After reading each statement carefully mark (✓) which suits the best in your case. Take special care to keep serial number while answering. Your data will be confidential and used only for research purposes. Please ensure you are responded to all the statements.

Sl. No.	Statements	Always	Sometimes	Never
1.	I know what are my strengths and weaknesses			
2.	I am not bothered about the method of learning different areas of a particular subject.			
3.	I used to evaluate how much I learned after learning section of a subject.			
4.	I don't think of suitable and necessary learning materials.			
5.	I am able to apply already learned things while studying new materials.			
6.	I am aware of the various elements which creates interest in learning.			

Sl. No.	Statements	Always	Sometimes	Never
7.	I find my own ways to overcome hurdles of learning.			
8.	I used to find out most suitable methods to learn different subjects.			
9.	I follow my own simple ways to attain curricular objectives.			
10.	I didn't identify learning strategies suitable for my learning style.			
11.	While solving learning problems I don't have insight in to its outcomes.			
12.	I used to feel proud of my achievements in learning.			
13.	In order to simplify learning task I keep punctuality.			
14.	In order to simplify my weaknesses in learning I make use of my strengths to the maximum			
15.	While doing learning activities I am not able to consider it from various angles.			
16.	I don't try to achieve my objectives by controlling different elements that affect learning.			
17.	I modify my learning style according to situations.			
18.	I do not think of novel strategies to enrich learning activities.			
19.	I know when and were to use a particular learning strategy on the basis of its effectiveness.			
20.	I don't identify which learning style lead to success.			
21.	I classify different subjects based on their importance.			
22.	I do not categorize lessons in advance based on the time allotted.			
23.	I do not solve problems before reading instructions and regulations.			
24.	I do not think of the importance of what is being learned.			
25.	I structurally analyze the aims and objectives of learning.			

Sl. No.	Statements	Always	Sometimes	Never
26.	I utilize all the available occasions to evaluate my demerits in learning.			
27.	I ask myself for the ways to improve planning of the learning.			
28.	I do not observe whether there is any change in my skills and thoughts as a result of learning.			
29.	I prefer self analysis to tests and questions.			
30.	I am aware of the factors that affects my thoughts.			
31.	I have identified the factors that influence my attention in learning.			
32.	After each lesson I used to evaluate myself using simple tests.			
33.	I try to keep away my feelings and emotions from learning.			
34.	I can understand factors that create interest in learning.			
35.	I know the importance of learning new concepts.			
36.	I do not realized what are the major concepts to be attained during learning process.			
37.	I discuss with my friends the concepts which are not clear in the class.			
38.	I try to find out myself ways and methods to enhance my learning through television and internet.			
39.	I used to identify my positions in the class based on teacher evaluation.			
40.	I like learning with help of various learning aids.			
41.	I think myself the use and availability of learning strategies.			
42.	While learning I do not try to integrate major concepts.			
43.	I do not prepare the possible questions from lessons in advance.			

Sl. No.	Statements	Always	Sometimes	Never
44.	I try to form new concepts based on the lessons.			
45.	When new theories and definitions are introduced in the class I do not think its origin.			
46.	If I find difficulty to take down lecture notes, I prepare my own notes.			
47.	Before trying to learn an area of lesson I don’t usually consider how it is prepared.			
48.	When I find any new lesson confusing I try to associate it to the lessons learned earlier for getting conceptual clarity.			
49.	When I read or listen conclusions of lessons, I used to think of other possibilities.			
50.	I used find out materials more suitable than those are used by teachers.			
51.	I used to relay on multiple strategies to analyse problems in the text books.			
52.	I do not analyse whether the learning styles go hand in hand with learning objectives.			
53.	I am aware of my personal responsibility in achieving general aims of learning.			

Appendix- B1

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF GOAL ORIENTATION
(Draft)

Dr. A. Hameed
Assistant Professor

Meharunnisa Karadan
Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:..

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:.............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

പഠനവുമായി ബന്ധപ്പെട്ട കാര്യങ്ങൾ ഏറ്റെടുത്ത് നടത്തുമ്പോഴും പഠന ശേഷം അവ വിലയിരുത്തുമ്പോഴും അതിലേക്കു നയിക്കുന്ന ചില ലക്ഷ്യങ്ങളും ഉദ്ദേശ്യങ്ങളും ഉണ്ടായിരിക്കും. അവയെ അടിസ്ഥാനമാക്കി രൂപീകിരിച്ചിരിക്കുന്ന ചില പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ച് നിങ്ങൾക്ക് ഏറ്റവും അനുയോജ്യമായ കോളത്തിൽ ശരി ചിഹ്നം (✓) അടയാളപ്പെടുത്തുക. നിങ്ങൾ നൽകുന്ന വിവരങ്ങൾ രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കുന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
1.	പഠനത്തിലൂടെ ഞാൻ ലക്ഷ്യമാക്കുന്നത് പുതിയ അറിവുകളും ആശയങ്ങളും നേടിയെടുക്കുക എന്നതാണ്.					
2.	പാഠഭാഗങ്ങൾ പരമാവധി ആഴത്തിലും വ്യാപ്തി യിലും മനസ്സിലാക്കണം എന്നത് എനിക്ക് നിർബ ന്ധമാണ്.					
3.	എല്ലാ പഠനസമയങ്ങളിലും പുതിയ കഴിവുകൾ കരസ്ഥമാക്കാനും ഉള്ളതിനെ മെച്ചപ്പെടുത്തു വാനും ഞാൻ ശ്രമിക്കാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
4.	മറ്റുള്ളവർ നിർബന്ധിക്കുന്നതു കൊണ്ടാണ് പഠന വുമായി ബന്ധപ്പെട്ട കാര്യങ്ങൾ ഞാൻ ചെയ്യുന്നത്.					
5.	വെല്ലുവിളി ഉയർത്തുന്നതാണെങ്കിലും പുതിയ അറിവുകൾ പകർന്നു തരുന്ന രീതിയിലുള്ള പാഠ ഭാഗങ്ങളെ ഞാൻ ഇഷ്ടപ്പെടുന്നു.					
6.	ബുദ്ധിമുട്ടുള്ളതും സാഹസികത ഉയർത്തുന്നതു മായ പഠനപ്രവർത്തനങ്ങൾ ലഘൂകരിക്കുന്നതിന് വേണ്ടി ഞാൻ പരമാവധി സമയം ചിലവഴിക്കാറു ണ്ട്.					
7.	പഠനകാര്യങ്ങളിൽ സംഭവിക്കുന്ന പരാജയങ്ങൾ എന്നെ പഠനത്തിൽനിന്ന് മാറ്റി നിർത്താറുണ്ട്.					
8.	പരീക്ഷകളിലെ പ്രകടനം മോശമായാൽ അതിന്റെ കാരണങ്ങൾ മനസ്സിലാക്കി മെച്ചപ്പെടുത്താൻ എനിക്ക് സാധിക്കാറില്ല.					
9.	അസൈൻമെന്റുകൾ എഴുതുമ്പോൾ ഉള്ളടക്ക ത്തിന്റെ പൂർണ്ണതയ്ക്കും ആധികാരികതയ്ക്കും ഞാൻ മുൻഗണന നൽകാറുണ്ട്.					
10.	ക്ലാസിലെ ചോദ്യവേളകളിൽ ചോദ്യങ്ങൾ വ്യക്ത മായി മനസ്സിലാക്കിയതിന് ശേഷം സ്വന്തമായി നിഗ മനങ്ങളിലെത്തിച്ചേരാൻ എനിക്ക് കഴിയാറുണ്ട്.					
11.	പഠനപ്രവർത്തനങ്ങളിൽ ഏർപ്പെടുന്നത് എന്നിൽ മാനസികമായ ഉല്ലാസത്തിനും ആസ്വാദനത്തിനും കാരണമാകാറില്ല.					
12.	വ്യക്തമായും സ്പഷ്ടമായും ആസൂത്രണം നട ത്തിയതിന് ശേഷം മാത്രമാണ് ഞാൻ പഠനത്തിന് തയ്യാറെടുക്കാറുള്ളത്.					
13.	നേടിയെടുത്ത അറിവുകളും ശേഷികളും സ്വയം വിലയിരുത്താൻ എനിക്ക് സാധിക്കാറില്ല.					
14.	സ്വന്തമായി പഠനപ്രവർത്തനങ്ങൾ ഏറ്റെടുക്കു കയും അത് പൂർത്തീകരിക്കുകയും ചെയ്യുന്നത് എനിക്കിഷ്ടമല്ല.					
15.	നേടിയെടുത്ത അറിവുകൾ മറ്റുള്ളവരുമായി ആശ യവിനിമയം നടത്തുന്നത് എനിക്ക് താത്പര്യമി ല്ലാത്ത കാര്യമാണ്.					
16.	ഗ്രേഡിന്റെയോ മാർക്കിന്റെയോ അടിസ്ഥാനത്തിൽ പഠനനിലവാരത്തെ മറ്റുള്ളവരുമായി താരതമ്യം നടത്തുന്നതിന് ഞാൻ പ്രാധാന്യം നൽകുന്നില്ല.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
17.	പാഠപുസ്തകങ്ങളിലെ ആശയങ്ങൾ വായിക്കുമ്പോൾ അതിന്റെ എല്ലാ തലങ്ങളിൽ നിന്നും ഞാൻ ചിന്തിക്കാറുണ്ട്.					
18.	പഠനസമയത്ത് ബാഹ്യചുറ്റുപാടുകളിൽ നിന്നുള്ള ശബ്ദങ്ങളോ മറ്റ് തടസ്സങ്ങളോ എന്റെ പഠനത്തെ ശല്യപ്പെടുത്താറില്ല.					
19.	പഠനത്തിന് വേണ്ടി വൈവിധ്യമാർന്ന സ്രോതസ്സുകളിൽ നിന്നും വിവരശേഖരണം നടത്താൻ ഞാൻ ശ്രമിക്കാറുണ്ട്.					
20.	പാഠഭാഗങ്ങൾ നന്നായി മനസ്സിലാക്കാൻ പരിശ്രമിക്കുക എന്നത് എനിക്ക് അത്രതന്നെ സംതൃപ്തി നൽകുന്ന കാര്യമല്ല.					
21.	അധ്യാപകർ ചോദ്യങ്ങൾ ചോദിക്കുന്ന സമയത്ത് അത് വ്യക്തമായി മനസ്സിലാക്കുകയും സ്വയം ഉത്തരങ്ങളിലെത്താൻ ശ്രമിക്കുകയും ചെയ്യാറുണ്ട്.					
22.	പഠനത്തിലൂടെ നേടിയെടുത്ത അറിവുകൾ ജീവിതത്തിലെ വ്യത്യസ്ത സാഹചര്യങ്ങളിൽ ഉപയോഗിക്കാൻ എനിക്ക് സാധിക്കാറില്ല.					
23.	പഠിച്ച കാര്യങ്ങൾ കൂടുതൽ കാലം ഓർമ്മയിൽ സൂക്ഷിക്കുന്നതിന് വേണ്ടി സ്വന്തമായി ചില മാർഗ്ഗങ്ങൾ ഞാൻ സ്വീകരിക്കാറുണ്ട്.					
24.	പഠനത്തിലേക്ക് താത്പര്യം ഉണ്ടാക്കുന്നതിന് എന്റെ മനസ്സിനെ ഞാൻ സ്വയം സന്നദ്ധമാക്കാറുണ്ട്.					
25.	'സ്വയം നന്നാവുക' എന്നത് എന്റെ ജീവിതത്തിലെ ആത്യന്തികമായ ലക്ഷ്യമായി ഞാൻ കണക്കാക്കുന്നു.					
26.	എനിക്ക് അറിയാത്ത കാര്യങ്ങൾ മറ്റുള്ളവരുരോട് ചോദിച്ചോ അല്ലെങ്കിൽ സ്വയം കണ്ടെത്തുകയോ ചെയ്ത സ്വയം വ്യക്തത വരുത്താറുണ്ട്.					
27.	പഠനസംബന്ധമായ എല്ലാ കാര്യങ്ങളിലും കഴിവിന്റെ പരമാവധി പരിശ്രമിക്കുക എന്നതാണ് എന്റെ നയം.					
28.	കൂട്ടത്തിൽ ഒന്നാമനാകുക എന്നതാണ് എനിക്ക് ഏറ്റവും സംതൃപ്തി നൽകുന്ന കാര്യം.					
29.	പഠനത്തിലൂടെ ഞാൻ ലക്ഷ്യമാക്കുന്നത് ക്ലാസിലെ മറ്റ് കുട്ടികളേക്കാളും മികച്ച ഗ്രേഡോ മാർക്കോ വാങ്ങിക്കുക എന്നതാണ്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
30.	പഠനപ്രവർത്തന സമയങ്ങളിൽ എന്റെ പ്രവർത്തനങ്ങളെ മറ്റ് കുട്ടികളുമായി താരതമ്യം ചെയ്യുന്നത് എനിക്ക് താത്പര്യമില്ല.					
31.	പഠനനിലവാരം അളക്കാത്ത സമയങ്ങളിൽ പഠനത്തിന് അത്ര തന്നെ പ്രാധാന്യം കൊടുക്കാൻ എനിക്ക് കഴിയാറില്ല.					
32.	അധ്യാപകരുടെ നിരീക്ഷണമുണ്ടാവാറുള്ളപ്പോൾ ഞാൻ പഠനത്തിൽ കൂടുതൽ ശ്രദ്ധ കാണിക്കാറുണ്ട്.					
33.	എന്റെ അറിവുകൾ മറ്റുള്ളവർക്ക് മുമ്പിൽ അവതരിപ്പിച്ച് അവരുടെ പ്രശംസനേടിയെടുക്കാൻ ഞാൻ ഇഷ്ടപ്പെടുന്നില്ല.					
34.	പരീക്ഷാസമയങ്ങളിൽ ഉയർന്ന ഗ്രേഡ് ലഭിക്കുന്നതിന് ഞാൻ ഉത്സാഹിച്ച് പഠിക്കാറുണ്ട്.					
35.	എളുപ്പമായതും ചുരുങ്ങിയ സമയം കൊണ്ടു ചെയ്തു തീർക്കാവുന്ന തരത്തിലുള്ളതുമായ പഠന പ്രവർത്തനങ്ങൾ ഏറ്റെടുക്കാനാണ് എനിക്ക് താത്പര്യം.					
36.	പഠനപ്രശ്നങ്ങൾ ലഘൂകരിക്കുന്നതിന് വേണ്ടി കൂടുതൽ സമയം ചലിവഴിക്കുക എന്നത് ഞാൻ ഇഷ്ടപ്പെടുന്ന കാര്യമാണ്.					
37.	ക്ലാസിൽ ഒന്നാമനാകുന്നതിന് വേണ്ടി ചോദ്യോത്തര വേളകളിൽ ഒട്ടും ആലോചിക്കാതെ ഉത്തരം പറയാൻ ഞാൻ ശ്രമിക്കാറില്ല.					
38.	അധ്യാപകർ, മാതാപിതാക്കൾ എന്നിവരുടെ പ്രോത്സാഹനം വഴി ഞാൻ പഠനത്തിനോട് കൂടുതൽ താത്പര്യം കാണിക്കാറില്ല.					
39.	എനിക്ക് ഒരുപാട് കാര്യങ്ങൾ അറിയാം എന്ന് എന്നെ കുറിച്ച് മറ്റുള്ളവർ ചിന്തിക്കുന്നത് എനിക്കിഷ്ടമില്ല.					
40.	കായികവേളകളിലും കലാമേളകളിലും ഉയർന്ന സ്ഥാനം കൈവരിക്കാൻ ഞാൻ ശ്രമിക്കാറില്ല.					
41.	പുതിയ നൈപുണികൾ വളർത്തിയെടുക്കുക എന്നത് എന്നെ സംബന്ധിച്ച് അത്രയ്ക്ക് പ്രാധാന്യമുള്ള കാര്യമല്ല.					
42.	മറ്റുള്ളവരുടെ അംഗീകാരം ലഭിക്കുന്ന കാര്യങ്ങൾ ചെയ്യാൻ ഞാൻ ശ്രമിക്കാറുണ്ട്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
43.	എളുപ്പത്തിൽ ലഭ്യമക്കുന്നതും ഒരേ തരത്തിലുള്ള തുമായ പഠന സാമഗ്രികളാണ് ഞാൻ ഉപയോഗി ക്കാറുള്ളത്.					
44.	കൂടുതൽ വിവരശേഖരമം നടത്താതെ അധ്യാപകർ പറയുന്ന തിയ്യതികളിൽ എന്റെ പഠനപ്രവർത്തന ങ്ങൾ പൂർത്തീകരിക്കാറുണ്ട്.					
45.	പഠനശാഖ തിരഞ്ഞെടുക്കുമ്പോൾ ഞാൻ ലക്ഷ്യ മാക്കുന്നത് കൂട്ടത്തിൽ വളരെ പിന്നിലാകാതിരി ക്കുക എന്നതാണ്.					
46.	പുതിയ അറിവുകളും ആശയങ്ങളും നേടിയെടു ക്കുന്നതിനോട് ഞാൻ താത്പര്യം കാണിക്കാറില്ല.					
47.	മറ്റുള്ളവരുടെ മുമ്പിൽ എന്റെ നിലവാരം കുറച്ച് കാണിക്കുന്ന പ്രവർത്തനങ്ങൾ ഞാൻ ഏറ്റെടുക്കാ റില്ല.					
48.	പഠനപ്രവർത്തനങ്ങൾ കൈകാര്യം ചെയ്യുമ്പോഴും പരീക്ഷാസമയങ്ങളിലും എനിക്ക് വളരെയധികം ഉത്കണ്ഠയുണ്ടാകാറുണ്ട്.					
49.	ക്ലാസിൽ പിന്നിൽ ആകുമോ എന്ന ഭയമാണ് എന്നെ പഠനത്തിലേക്ക് നയിക്കുന്നത്.					
50.	പരാജയപ്പെടും എന്ന തോന്നലുള്ളതിനാൽ കലാ-കായിക മേളകളിൽ ഞാൻ പങ്കെടുക്കാറില്ല.					
51.	പരാജയ സാധ്യതയുള്ളതോ കൂട്ടത്തിൽ പിന്നി ലേക്ക് നയിക്കുന്നതോ ആയ രീതിയിലുള്ള പഠന പ്രശ്നങ്ങൾ ഞാൻ ഏറ്റെടുക്കാറില്ല.					
52.	ഓരോ പഠനവിലയിരുത്തലിനു ശേഷവും അതി ലൂടെ എന്റെ ഗ്രേഡ് നില ഉയർന്നോ ഇല്ലയോ എന്നതിനെകുറിച്ച് ഞാൻ വ്യാകുലപ്പെടാറില്ല.					
53.	ചില കാര്യങ്ങളിൽ എനിക്കുള്ള അജ്ഞത മറ്റുള്ളവ ർക്ക് തോന്നാതിരിക്കാൻ ഞാൻ പലപ്പോഴും ശ്രമി ക്കാറുണ്ട്.					
54.	എനിക്ക് പൂർത്തീകരിക്കാൻ സാധിക്കാത്ത രീതിയി ലുള്ള പ്രവർത്തനങ്ങൾ ഞാൻ ഒഴിവാക്കുകയാണ് ചെയ്യാറുള്ളത്.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
55.	എന്റെ കഴിവില്ലായ്മ പുറത്ത് കാണിക്കാതിരുക്കുക എന്നതിനാണ് പുതിയ ശേഷികളും അറിവുകളും കരസ്ഥമാക്കുന്നതിനേക്കാൾ ഞാൻ പ്രാധാന്യം കൽപ്പിക്കുന്നത്.					
56.	എന്നെക്കുറിച്ച് മറ്റുള്ളവർ നല്ല അഭിപ്രായങ്ങൾ മാത്രമേ പറയാവൂ എന്ന കാര്യം ഞാൻ ശ്രദ്ധിക്കാറുണ്ട്.					
57.	പഠനത്തിന്റെ പൊതു ലക്ഷ്യം കൈവരിക്കുന്നതിന് വേണ്ടി ഗ്രൂപ്പ് പ്രവർത്തനങ്ങളിൽ പൂർണ്ണമായും സഹകരിക്കാറില്ല.					
58.	എന്റെ പോരായ്മകൾ വിലയിരുത്തുകയും അത് പരിഹരിക്കുന്നതിനാവശ്യമായ കാര്യങ്ങൾ ചെയ്യുന്നതിനും എനിക്ക് സാധിക്കാറില്ല.					
59.	എന്റെ പോരായ്മകളെ മറച്ചുവെച്ച് കൊണ്ട് അധ്യാപകരുടെ മുമ്പിൽ ശരാശരി പഠനനിലവാരം പ്രകടിപ്പിക്കാൻ ഞാൻ പരമാവധി ശ്രദ്ധിക്കാറുണ്ട്.					
60.	പഠനകാര്യങ്ങളുടെ ആസൂത്രണം, നടത്തിപ്പ് എന്നിവ സ്വയം ചെയ്യുന്നതിനോട് എനിക്ക് താത്പര്യമില്ല.					
61.	അധ്യാപകർ നടത്തുന്ന വിലയിരുത്തൽ രീതിയ്ക്കു പുറമേ സ്വയം വിലയിരുത്തൽ ഞാൻ നടത്താറില്ല					

Appendix – B2

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF GOAL ORIENTATION
(Draft)

Dr. A. Hameed — Assistant Professor

Meharunnisa Karadan — Research Scholar

Name of the Student:..

Name of the School:.. Class:............

Male/Female:.. Govt./Aided/Unaided

Instructions:

There are certain aims and objectives when we take up an activity as a part of learning and evaluation after completion of learning process. Following are some statements based on such aims and objectives. After reading each statement carefully put a tick (✓) mark in the most appropriate column. Your data will be kept confidential and used only for research purposes. Please take care to respond to all the statements.

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	I am aim at attaining new knowledge and concepts through learning.					
2.	I am particular about conceiving lessons wider and deeper.					
3.	I always try to refine my skills and learn new skills.					
4.	I complete learning activities because of others compulsion.					
5.	I like lesson that provide new knowledge even though they are challenging.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
6.	I spend maximum time to simplify most difficult and challenging problems.					
7.	Failures keep me away from further learning.					
8.	When my performance in examination is poor I am not able to identify the problems and rectify them.					
9.	I prefer perfection and authenticity of the contents when I prepare assignments.					
10.	When questions are asked in the class I am able to comprehend them properly and draw my own conclusions.					
11.	Involvement in learning activities will not give me enjoyment.					
12.	I usually start learning after clear and specific planning.					
13.	I can’t evaluate myself the skills and knowledge attained.					
14.	I don’t like taking up activities and completing it by myself.					
15.	I am not interested in sharing with others the knowledge I have acquired.					
16.	I don’t think it is important to compare my level of achievement with others in terms of grade and marks secured.					
17.	When I go through the concepts in the textbook I consider them from all the aspects.					
18.	During the time of my learning, noise and other hindrances around will not disturb me.					
19.	I try to collect data from vivid sources.					
20.	I try to understand lessons properly is not that much pleasing for me.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
21.	When teachers ask questions I try to understand them properly and to find out answer myself.					
22.	I fail to apply the knowledge I gained through learning in various life situations.					
23.	I adopt my own techniques to keep in memory what I have learned for long time.					
24.	I am mentally prepared to encourage myself in learning.					
25.	I consider self refinement is the prime aim of my life.					
26.	I used to clarify the things that I do not know by asking others or finding out myself.					
27.	To try maximum is my policy of learning.					
28.	To become first among others is a pleasing thing.					
29.	My aim is to score more marks and grades from than the other students in the class.					
30.	I don’t like comparing my activities with others.					
31.	I am unable to give importance to learning when it is not evaluated.					
32.	I concentrate on learning more, when observed by the teachers’					
33.	I don’t like appreciated by exhibiting my knowledge infront of others.					
34.	I learn energetically to score higher grades at the time of examination.					
35.	I like engaging in simple activities that can be completed within a short time.					
36.	When I solve problems in the class I usually spend more time on it.					
37.	I don’t answer the questions without thinking inorder to become the first to answer.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
38.	I am not influenced by the encouragements of parents and teachers.					
39.	I don’t like others think that, I know everything.					
40.	I don’t try to win in arts and sports meets.					
41.	I do not consider it is important to develop new skills.					
42.	I try to do things so that others will approve me.					
43.	I use easily available and similar learning materials.					
44.	I complete my learning activities within stipulated time without proper data collection.					
45.	When I have to select the learning item my intention is not to be backward in the class.					
46.	I don’t show interest in achieving knowledge and new concepts.					
47.	I will take up activities that may cause my status before others.					
48.	While doing learning activities and preparing for examinations I feel anxious.					
49.	The fear of being backward in the class leads me in to learning.					
50.	I don’t participate in arts and sports competitions for fear of failure.					
51.	I don’t usually take up activities that may cause failure or that may push me downwards.					
52.	After each evaluation I am not bothered whether any grade level up or down.					
53.	I try to hide my ignorance about anything from others.					
54.	I avoid activities that can’t be completed by me.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
55.	I give preference to hide my inability than to acquire new knowledge and skills.					
56.	I am very particular about impressing others.					
57.	I do not co-operate in group activities completely inorder to achieve aims of learning.					
58.	I am not able to evaluate defects and solve it.					
59.	I try to keep an average level of performance infront of my teachers without revealing my weaknesses.					
60.	I am not interested in planning but execution of learning activities by myself.					
61.	I don’t evaluate myself other than teacher evaluation.					

Appendix- B3

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF GOAL ORIENTATION

(Final)

Dr. A. Hameed | **Meharunnisa Karadan**
Assistant Professor | Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:...

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:.............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

പഠനവുമായി ബന്ധപ്പെട്ട കാര്യങ്ങൾ ഏറ്റെടുത്ത് നടത്തുമ്പോഴും പഠന ശേഷം അവ വിലയിരുത്തുമ്പോഴും അതിലേക്കു നയിക്കുന്ന ചില ലക്ഷ്യങ്ങളും ഉദ്ദേശ്യങ്ങളും ഉണ്ടായിരിക്കും. അവയെ അടിസ്ഥാനമാക്കി രൂപീകിരിച്ചിരിക്കുന്ന ചില പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ച് നിങ്ങൾക്ക് ഏറ്റവും അനുയോജ്യമായ കോളത്തിൽ ശരി ചിഹ്നം (✓) അടയാളപ്പെടുത്തുക. നിങ്ങൾ നൽകുന്ന വിവരങ്ങൾ രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കുന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
1.	പഠനത്തിലൂടെ ഞാൻ ലക്ഷ്യമാക്കുന്നത് പുതിയ അറിവുകളും ആശയങ്ങളും നേടിയെടുക്കുക എന്നതാണ്.					
2.	പാഠഭാഗങ്ങൾ പരമാവധി ആഴത്തിലും വ്യാപ്തി യിലും മനസ്സിലാക്കണം എന്നത് എനിക്ക് നിർബ ന്ധമാണ്.					
3.	എല്ലാ പഠനസമയങ്ങളിലും പുതിയ കഴിവുകൾ കരസ്ഥമാക്കാനും ഉള്ളതിനെ മെച്ചപ്പെടുത്തു വാനും ഞാൻ ശ്രമിക്കാറുണ്ട്.					
4.	വെല്ലുവിളി ഉയർത്തുന്നതാണെങ്കിലും പുതിയ അറിവുകൾ പകർന്നു തരുന്ന രീതിയിലുള്ള പാഠ ഭാഗങ്ങളെ ഞാൻ ഇഷ്ടപ്പെടുന്നു.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
5.	ബുദ്ധിമുട്ടുള്ളതും സാഹസികത ഉയർത്തുന്നതുമായ പഠനപ്രവർത്തനങ്ങൾ ലഘൂകരിക്കുന്നതിന് വേണ്ടി ഞാൻ പരമാവധി സമയം ചിലവഴിക്കാറുണ്ട്.					
6.	പഠനകാര്യങ്ങളിൽ സംഭവിക്കുന്ന പരാജയങ്ങൾ എന്നെ പഠനത്തിൽനിന്ന് മാറ്റി നിർത്താറുണ്ട്.					
7.	അസൈൻമെന്റുകൾ എഴുതുമ്പോൾ ഉള്ളടക്കത്തിന്റെ പൂർണ്ണതയ്ക്കും ആധികാരികതയ്ക്കും ഞാൻ മുൻഗണന നൽകാറുണ്ട്.					
8.	ക്ലാസിലെ ചോദ്യവേളകളിൽ ചോദ്യങ്ങൾ വ്യക്തമായി മനസ്സിലാക്കിയതിന് ശേഷം സ്വന്തമായി നിഗമനങ്ങളിലെത്തിച്ചേരാൻ എനിക്ക് കഴിയാറുണ്ട്.					
9.	വ്യക്തമായും സ്പഷ്ടമായും ആസൂത്രണം നടത്തിയതിന് ശേഷം മാത്രമാണ് ഞാൻ പഠനത്തിന് തയ്യാറെടുക്കാറുള്ളത്.					
10.	നേടിയെടുത്ത അറിവുകളും ശേഷികളും സ്വയം വിലയിരുത്താൻ എനിക്ക് സാധിക്കാറില്ല.					
11.	ഗ്രേഡിന്റെയോ മാർക്കിന്റെയോ അടിസ്ഥാനത്തിൽ പഠനനിലവാരത്തെ മറ്റുള്ളവരുമായി താരതമ്യം നടത്തുന്നതിന് ഞാൻ പ്രാധാന്യം നൽകുന്നില്ല.					
12.	പാഠപുസ്തകങ്ങളിലെ ആശയങ്ങൾ വായിക്കുമ്പോൾ അതിന്റെ എല്ലാ തലങ്ങളിൽ നിന്നും ഞാൻ ചിന്തിക്കാറുണ്ട്.					
13.	പഠനസമയത്ത് ബാഹ്യചുറ്റുപാടുകളിൽ നിന്നുള്ള ശബ്ദങ്ങളോ മറ്റ് തടസ്സങ്ങളോ എന്റെ പഠനത്തെ ശല്യപ്പെടുത്താറില്ല.					
14.	പഠനത്തിന് വേണ്ടി വൈവിധ്യമാർന്ന സ്രോതസ്സുകളിൽ നിന്നും വിവരശേഖരണം നടത്താൻ ഞാൻ ശ്രമിക്കാറുണ്ട്.					
15.	അധ്യാപകർ ചോദ്യങ്ങൾ ചോദിക്കുന്ന സമയത്ത് അത് വ്യക്തമായി മനസ്സിലാക്കുകയും സ്വയം ഉത്തരങ്ങളിലെത്താൻ ശ്രമിക്കുകയും ചെയ്യാറുണ്ട്.					
16.	പഠനത്തിലൂടെ നേടിയെടുത്ത അറിവുകൾ ജീവിതത്തിലെ വ്യത്യസ്ത സാഹചര്യങ്ങളിൽ ഉപയോഗിക്കാൻ എനിക്ക് സാധിക്കാറില്ല.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
17.	പഠിച്ച കാര്യങ്ങൾ കൂടുതൽ കാലം ഓർമ്മയിൽ സൂക്ഷിക്കുന്നതിന് വേണ്ടി സ്വന്തമായി ചില മാർഗ്ഗങ്ങൾ ഞാൻ സ്വീകരിക്കാറുണ്ട്.					
18.	പഠനത്തിലേക്ക് താത്പര്യം ഉണ്ടാക്കുന്നതിന് എന്റെ മനസ്സിനെ ഞാൻ സ്വയം സന്നദ്ധമാക്കാറുണ്ട്.					
19.	‘സ്വയം നന്നാവുക’ എന്നത് എന്റെ ജീവിതത്തിലെ ആത്യന്തികമായ ലക്ഷ്യമായി ഞാൻ കണക്കാക്കുന്നു.					
20.	പഠനസംബന്ധമായ എല്ലാ കാര്യങ്ങളിലും കഴിവിന്റെ പരമാവധി പരിശ്രമിക്കുക എന്നതാണ് എന്റെ നയം.					
21.	കൂട്ടത്തിൽ ഒന്നാമനാകുക എന്നതാണ് എനിക്ക് ഏറ്റവും സംതൃപ്തി നൽകുന്ന കാര്യം.					
22.	പഠനത്തിലൂടെ ഞാൻ ലക്ഷ്യമാക്കുന്നത് ക്ലാസിലെ മറ്റ് കുട്ടികളേക്കാളും മികച്ച ഗ്രേഡോ മാർക്കോ വാങ്ങിക്കുക എന്നതാണ്.					
23.	പഠനനിലവാരം അളക്കാത്ത സമയങ്ങളിൽ പഠനത്തിന് അത്ര തന്നെ പ്രാധാന്യം കൊടുക്കാൻ എനിക്ക് കഴിയാറില്ല.					
24.	അധ്യാപകരുടെ നിരീക്ഷണമുണ്ടാവാറുള്ളപ്പോൾ ഞാൻ പഠനത്തിൽ കൂടുതൽ ശ്രദ്ധ കാണിക്കാറുണ്ട്.					
25.	എന്റെ അറിവുകൾ മറ്റുള്ളവർക്ക് മുമ്പിൽ അവതരിപ്പിച്ച് അവരുടെ പ്രശംസനേടിയെടുക്കാൻ ഞാൻ ഇഷ്ടപ്പെടുന്നില്ല.					
26.	പരീക്ഷാസമയങ്ങളിൽ ഉയർന്ന ഗ്രേഡ് ലഭിക്കുന്നതിന് ഞാൻ ഉത്സാഹിച്ച് പഠിക്കാറുണ്ട്.					
27.	എളുപ്പമായതും ചുരുങ്ങിയ സമയം കൊണ്ടു ചെയ്തു തീർക്കാവുന്ന തരത്തിലുള്ളതുമായ പഠന പ്രവർത്തനങ്ങൾ ഏറ്റെടുക്കാനാണ് എനിക്ക് താത്പര്യം.					
28.	എനിക്ക് ഒരുപാട് കാര്യങ്ങൾ അറിയാം എന്ന് എന്നെ കുറിച്ച് മറ്റുള്ളവർ ചിന്തിക്കുന്നത് എനിക്കിഷ്ടമില്ല.					
29.	പുതിയ നൈപുണികൾ വളർത്തിയെടുക്കുക എന്നത് എന്നെ സംബന്ധിച്ച് അത്രയ്ക്ക് പ്രാധാന്യമുള്ള കാര്യമല്ല.					

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	പൂർണ്ണമായി യോജിക്കുന്നു	യോജിക്കുന്നു	അഭിപ്രായമില്ല	വിയോജിക്കുന്നു	പൂർണ്ണമായി വിയോജിക്കുന്നു
30.	മറ്റുള്ളവരുടെ അംഗീകാരം ലഭിക്കുന്ന കാര്യങ്ങൾ ചെയ്യാൻ ഞാൻ ശ്രമിക്കാറുണ്ട്.					
31.	കൂടുതൽ വിവരശേഖരമം നടത്താതെ അധ്യാപകർ പറയുന്ന തിയ്യതികളിൽ എന്റെ പഠനപ്രവർത്തനങ്ങൾ പൂർത്തീകരിക്കാറുണ്ട്.					
32.	പഠനപ്രവർത്തനങ്ങൾ കൈകാര്യം ചെയ്യുമ്പോഴും പരീക്ഷാസമയങ്ങളിലും എനിക്ക് വളരെയധികം ഉത്കണ്ഠയുണ്ടാകാറുണ്ട്.					
33.	ക്ലാസിൽ പിന്നിൽ ആകുമോ എന്ന ഭയമാണ് എന്നെ പഠനത്തിലേക്ക് നയിക്കുന്നത്.					
34.	ചില കാര്യങ്ങളിൽ എനിക്കുള്ള അജ്ഞത മറ്റുള്ളവർക്ക് തോന്നാതിരിക്കാൻ ഞാൻ പല പ്പോഴും ശ്രമിക്കാറുണ്ട്.					
35.	എനിക്ക് പൂർത്തീകരിക്കാൻ സാധിക്കാത്ത രീതിയി ലുള്ള പ്രവർത്തനങ്ങൾ ഞാൻ ഒഴിവാക്കുകയാണ് ചെയ്യാറുള്ളത്.					
36.	പഠനത്തിന്റെ പൊതു ലക്ഷ്യം കൈവരിക്കുന്നതിന് വേണ്ടി ഗ്രൂപ്പ് പ്രവർത്തനങ്ങളിൽ പൂർണ്ണമായും സഹകരിക്കാറില്ല.					
37.	എന്റെ പോരായ്മകളെ മറച്ചുവെച്ച് കൊണ്ട് അധ്യാപകരുടെ മുമ്പിൽ ശരാശരി പഠനനിലവാരം പ്രകടിപ്പിക്കാൻ ഞാൻ പരമാവധി ശ്രദ്ധിക്കാറുണ്ട്.					
38.	പഠനകാര്യങ്ങളുടെ ആസൂത്രണം, നടത്തിപ്പ് എന്നിവ സ്വയം ചെയ്യുന്നതിനോട് എനിക്ക് താത്പര്യമില്ല.					

Appendix- B4

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF GOAL ORIENTATION
(Final)

Dr. A. Hameed **Meharunnisa Karadan**
Assistant Professor Research Scholar

Name of the Student:...

Name of the School:.. Class:............

Male/Female:... Govt./Aided/Unaided

Instructions:

There are certain aims and objectives when we take up an activity as a part of learning and evaluation after completion of learning process. Following are some statements based on such aims and objectives. After reading each statement carefully put a tick (✓) mark in the most appropriate column. Our data will be confidential and used only for research purposes. Please take care to respond to all the statements.

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	I am aim at attaining new knowledge and concepts through learning.					
2.	I am particular about conceiving lessons wider and deeper.					
3.	I always try to refine my skills and learn new skills.					
4.	I like lesson that provide new knowledge even though they are challenging.					
5.	I spend maximum times to simplify most difficult and challenging problems.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
6.	Failures keep me away from further learning.					
7.	I prefer perfection and authenticity of the contents when I prepare assignments.					
8.	When questions are asked in the class I am able to comprehend them properly and draw my own conclusions.					
9.	I usually start learning after clear and specific planning.					
10.	I can't evaluate myself the skills and knowledge attained.					
11.	I don't think it is important to compare my level of achievement with others in terms of grade and marks secured.					
12.	When I go through the concepts in the textbook I consider them from all the aspects.					
13.	During the time of my learning, noise and other hindrances around will not disturb me.					
14.	I try to collect data from vivid sources.					
15.	When teachers ask questions I try to understand them properly and to find out answer myself.					
16.	I fail to apply the knowledge I gained through learning in various life situations.					
17.	I adopt my own techniques to keep in memory what I have learned for long time.					
18.	I am mentally prepared to encourage myself in learning.					
19.	I consider self refinement is the prime aim of my life.					
20.	To try maximum is my policy of learning.					
21.	To become first among others is a pleasing thing.					
22.	My aim is to score more marks and grades from than the other students in the class.					

Sl. No	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
23.	I am unable to give importance to learning when it is not evaluated.					
24.	I concentrate on learning more, when observed by the teachers'					
25.	I don't like appreciated by exhibiting my knowledge infront of others.					
26.	I learn energetically to score higher grades at the time of examination.					
27.	I like engaging in simple activities that can be completed within a short time.					
28.	I don't like others think that, I know everything.					
29.	I do not consider it is important to develop new skills.					
30.	I try to do things so that others will approve me.					
31.	I complete my learning activities within stipulated time without proper data collection.					
32.	While doing learning activities and preparing for examinations I feel anxious.					
33.	The fear of being backward in the class leads me in to learning.					
34.	I try to hide my ignorance about anything from others.					
35.	I avoid activities that can't be completed by me.					
36.	I do not co-operate in group activities completely inorder to achieve aims of learning.					
37.	I try to keep an average level of performance infront of my teachers without revealing my weaknesses.					
38.	I am not interested in planning but execution of learning activities by myself.					

Appendix- C1

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

LEARNING STYLE INVENTORY
(Draft)

Dr. A. Hameed Assistant Professor

Meharunnisa Karadan Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:..

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:.............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

നിങ്ങളുടെ പഠനരീതി എങ്ങിനെയാണ് എന്നറിയുന്നതിനുള്ള ചില പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയ്ക്കും 'എല്ലായ്പ്പോഴും', 'ചിലപ്പോൾ മാത്രം', 'ഒരിക്കലുമില്ല' എന്നിങ്ങനെ മൂന്ന് പ്രതികരണങ്ങൾ നൽകിയിട്ടുണ്ട്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ചതിന് ശേഷം നിങ്ങൾ ഏറ്റവും യോജിക്കന്നതിന്റെ നേരെ ശരി ചിഹ്നം '✓' രേഖപ്പെടുത്തുക. നിങ്ങൾ നൽകുന്ന വിവരം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കുന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	**പ്രസ്താവനകൾ**	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
1.	എനിക്ക് പരിചിതമല്ലാത്ത ഒരു ഉപകരണം പ്രവർത്തിപ്പിക്കുമ്പോൾ ഞാൻ ആദ്യം അതിലെ നിർദ്ദേശങ്ങൾ വായിക്കുകയാണ് ചെയ്യാറുള്ളത്.			
2.	ദൃശ്യമാധ്യമങ്ങളായ ബ്ലാക്ക്ബോർഡ്, ടെലിവിഷൻ എന്നിവ പഠനസാമഗ്രികളായി ഉപയോഗിക്കാറുണ്ട്.			
3.	ക്ലാസിനിടയ്ക്ക് ആശയങ്ങൾ നോട്ട്ബുക്കിലോ മറ്റേതെങ്കിലും രീതിയിലോ ഞാൻ വിശദമായി എഴുതി വെയ്ക്കാറുണ്ട്.			
4.	ഗ്രാഫ്, ഭൂപടം, ചിത്രങ്ങൾ എന്നിവ ഞാൻ ആശയങ്ങൾ രേഖപ്പെടുത്താൻ വേണ്ടി ഉപയോഗിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
5.	പഠനാഭ്യാസങ്ങൾ പൂർത്തീകരിക്കുന്ന സമയത്ത് അതുമായി ബന്ധപ്പെട്ട പാഠപുസ്തകത്തിലെ പ്രസ്തുത ഭാഗത്തിന്റെ ചിത്രം എന്റെ മനസ്സിലേക്ക് വരാറുണ്ട്			
6.	ടെക്സ്റ്റ് ബുക്ക്, നോട്ടബുക്ക് എന്നിവയിലെ പ്രധാനപ്പെട്ട ആശയങ്ങൾ കളർപേന ഉപയോഗിച്ച് ഞാൻ അടിവരയിട്ട് വെയ്ക്കാറുണ്ട്.			
7.	അധ്യാപകരുടെ ഭാവങ്ങളും ആംഗ്യങ്ങളും നിരീക്ഷിച്ച് പാഠഭാഗം പഠിക്കുന്നതിന് വേണ്ടി ക്ലാസിലെ മുൻബെഞ്ചി ലാണ് ഞാൻ ഇരിക്കാറുള്ളത്.			
8.	പേടിയുണ്ടാകുന്ന സന്ദർഭങ്ങളിൽ അതുമായി ബന്ധപ്പെട്ട കാര്യങ്ങളുടെ ചിത്രങ്ങളാണ് ആദ്യം എന്റെ മനസ്സിലേക്ക് വരാറുള്ളത്.			
9.	കൂടുതൽ സമയം നീണ്ടു നിൽക്കാറുള്ള ക്ലാസ്സുകൾ ശ്രദ്ധിക്കുമ്പോൾ എനിക്ക് പ്രയാസമുണ്ടാകാറുണ്ട്.			
10.	അധ്യാപകർ ക്ലാസിൽ പറയുന്ന കാര്യം മനസ്സിലാകണമെ ങ്കിൽ എനിക്ക് അവരുടെ മുഖത്ത് നോക്കണം.			
11.	മറ്റുള്ളവരെക്കുറിച്ച് ആലോചിക്കുമ്പോൾ അവരുടെ പേരി നേക്കാളും അവരുടെ മുഖമാണ് എന്റെ ഓർമ്മയിൽ വരാറു ള്ളത്.			
12.	ക്ലാസിൽ കണ്ടു പഠിച്ച കാര്യങ്ങളേക്കാൾ കേട്ടു പഠിച്ച കാര്യങ്ങൾക്കാണ് ഞാൻ പ്രാധാന്യം കൊടുക്കാറുള്ളത്.			
13.	ഓരോ വാക്കുകളിലേയും അക്ഷരങ്ങളെ ചിത്രങ്ങളായി കാണുന്നതുകൊണ്ട് എനിക്ക് അവയുടെ സ്പെല്ലിംഗ് കൂടുതൽ ഓർക്കാൻ കഴിയാറുണ്ട്.			
14.	സ്ഥലങ്ങളും വഴികളും വരച്ച് കാണിക്കുന്നതിനേക്കാൾ അത് പറഞ്ഞ് തരുമ്പോഴാണ് എനിക്ക് മനസ്സിലാകാറുള്ളത്.			
15.	വായിക്കുന്ന സമയങ്ങളിൽ പുറമെ നിന്നുള്ള ശബ്ദകോലാഹലങ്ങൾ എന്നെ ഒട്ടും തടസ്സപ്പെടുത്താറില്ല.			
16.	എന്നെ സംബന്ധിച്ചിടത്തോളം കാര്യങ്ങൾ ഓർമ്മയിൽ ഉറപ്പിക്കുവാനുള്ള എളുപ്പമാർഗ്ഗം അവ ഭാവനയിൽ കാണുന്നതാണ്.			
17.	പുസ്തകങ്ങൾ, വസ്ത്രങ്ങൾ എന്നിവ പരമാവധി നല്ല രീതിയിൽ ഞാൻ ഒരുക്കി വെയ്ക്കാറുണ്ട്.			
18.	മലയാളം, ഇംഗ്ലീഷ് എന്നിവ നല്ല വൃത്തിയായും ഭംഗി യായും ഞാൻ എഴുതാറുണ്ട്.			
19.	പരീക്ഷാസമയങ്ങളിൽ പുനർവായനയ്ക്ക് ചെറിയ കുറിപ്പു കളും ചിത്രങ്ങളുമാണ് ഉപയോഗിക്കാറുള്ളത്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
20.	ഒഴിവുസമയങ്ങളിൽ മ്യൂസിയങ്ങൾ, ഗാലറികൾ എന്നിവ സന്ദർശിക്കുന്നത് ഞാൻ ഏറെ ഇഷ്ടപ്പെടുന്നു.			
21.	മുൻകൂട്ടി നിശ്ചയിച്ചിട്ടുള്ള ലിസ്റ്റുകൾ, ഷെഡ്യൂൾ എന്നിവ പ്രയോഗിക്കാതെ ഞാൻ ഒരു കാര്യവും ചെയ്യാറില്ല.			
22.	വിഷമങ്ങളോ സങ്കടങ്ങളോ ഉണ്ടാകുന്ന സമയത്ത് എന്റെ മുഖഭാവം പെട്ടെന്ന് മാറാറുണ്ട്.			
23.	പുതിയ ഒരു സാധനം വാങ്ങിക്കുന്നതിനു മുമ്പ് അതിനെക്കുറിച്ച് പത്രമാധ്യമങ്ങളിലൂടെയോ മറ്റോ മനസ്സിലാക്കാൻ ശ്രമിക്കാറുണ്ട്.			
24.	സിനിമകളിൽ ഞാൻ ഏറ്റവും കൂടുതൽ ഓർക്കുന്നത് അതിലെ വസ്ത്രധാരണ രീതികൾ, രംഗസജ്ജീകരണങ്ങൾ എന്നിവയാണ്.			
25.	വസ്ത്രധാരണം, രൂപഭംഗി എന്നിവ നോക്കിയാണ് ഞാൻ മറ്റുള്ളവരെ വിലയിരുത്താറുള്ളത്.			
26.	എന്റെ സംസാരത്തിൽ അധികവും ഞാൻ കണ്ട കാഴ്ച്ചകളെക്കുറിച്ചും, വസ്തുക്കളുടെ രൂപഭാവത്തെക്കുറിച്ചുമാണ് ഉണ്ടാവാറുള്ളത്.			
27.	ഒഴിവുസമയങ്ങളിൽ അധികവും ഞാൻ പാട്ടു കേൾക്കുകയാണ് പതിവ്.			
28.	പാഠഭാഗങ്ങൾ ഉച്ചത്തിൽ ഉരുവിട്ട് പഠിക്കാനാണ് എനിക്കിഷ്ടം.			
29.	പഠനസമയങ്ങളിൽ ചിലപ്പോൾ ഞാൻ എന്നോട് തന്നെ സംസാരിക്കാറുണ്ട്.			
30.	സാധാരണയായി ക്ലാസിലെ മുൻബെഞ്ചിൽ നിവർന്നോ അല്ലെങ്കിൽ മുമ്പോട്ടാഞ്ഞോ ആണ് ഞാൻ ഇരിക്കാറുള്ളത്.			
31.	പാഠഭാഗങ്ങൾ സംഗീതം കേട്ടുകൊണ്ടു പഠിക്കുന്നതാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
32.	പഠിച്ച ആശയങ്ങൾ മനസ്സിലുറപ്പിക്കുന്നതിനുവേണ്ടി ഞാൻ അവ ആവർത്തിച്ച് പറഞ്ഞു നോക്കാറുണ്ട്.			
33.	നേരിട്ടുള്ള സംസാരത്തിലൂടെയോ ഫോൺ സംഭാഷണത്തിലൂടെയോ എനിക്ക് വ്യക്തികളെ തിരിച്ചറിയാൻ കഴിയാറില്ല.			
34.	എന്റെ സംസാരത്തിന്റെ വേഗത മറ്റുള്ളവരേക്കാൾ കൂടുതലാണ്.			
35.	ഞാൻ ടെക്സ്റ്റ് ബുക്കുകൾ വായിച്ചുകൊണ്ടിരിക്കുമ്പോൾ ചുണ്ടുകൾ കൊണ്ട് ശബ്ദമില്ലാതെ മന്ത്രിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
36.	എഴുതപ്പെട്ട നിർദ്ദേശങ്ങളേക്കാൾ വാക്കാലുള്ള നിർദ്ദേശങ്ങളാണ് എനിക്ക് താത്പര്യം.			
37.	പിന്നീട് കേൾക്കുന്നതിന് വേണ്ടി ഞാൻ ക്ലാസുകൾ റെക്കോർഡ് ചെയ്ത് വെക്കാറുണ്ട്.			
38.	ക്ലാസ്സിലിരുന്ന് പാഠഭാഗങ്ങൾ ശ്രദ്ധിക്കുന്ന സമയത്ത് ഞാൻ തലയാട്ടാറുണ്ട്.			
39.	പുതിയ ഉപകരണങ്ങൾ പ്രവർത്തിപ്പിക്കുന്നതിന് മുമ്പ് അതു പയോഗിച്ച് പരിചയമുള്ളവരുമായി സംസാരിക്കാറുണ്ട്.			
40.	സന്തോഷം, സങ്കടം എന്നീ വികാരങ്ങളുണ്ടാകുമ്പോൾ എന്റെ ശബ്ദത്തിൽ വ്യത്യാസം വരാറുണ്ട്.			
41.	പരിചിതമല്ലാത്ത ഒരു സ്ഥലത്ത്കൂടി സഞ്ചരിക്കുമ്പോൾ വഴിയറിയുന്നതിന് മറ്റുള്ളവരോട് ചോദിക്കുകയാണ് ചെയ്യാറുള്ളത്.			
42.	അധ്യാപകരുടെ വാക്കാലുള്ള പ്രോത്സാഹനമാണ് മറ്റുള്ള രീതികളേക്കാൾ എന്നെ പഠനത്തിലേക്ക് നയിക്കാറുള്ളത്.			
43.	സിനിമകളിലെ ഡയലോഗ്, പശ്ചാത്തല സംഗീതം, ശബ്ദം എന്നിവയാണ് ഞാൻ കൂടുതൽ ഓർക്കാറുള്ളത്.			
44.	പഠനത്തിന് വേണ്ടി ഞാൻ ഉപയോഗിക്കാറുള്ള നോട്ട്ബുക്കുകൾ, പേപ്പറുകൾ എന്നിവ ഞാൻ വൃത്തിയായി സൂക്ഷിക്കാറില്ല.			
45.	വായിച്ച് പഠിക്കുന്നതിന് പകരം പാഠ്യവസ്തുക്കൾ നേരിട്ട് കൈകാര്യം ചെയ്തു പഠിക്കാനാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
46.	വൈവിധ്യമാർന്ന ശാരീരിക പ്രവർത്തനങ്ങൾ അടങ്ങിയിട്ടുള്ള ക്ലാസ്റൂം പ്രവർത്തനങ്ങളോട് എനിക്ക് താത്പര്യം ഉണ്ട്.			
47.	പഠനസമയങ്ങളിൽ ഞാൻ ഇടവിട്ട് വിശ്രമവേളകൾ എടുത്ത് പഠനസമയം അധികരിപ്പിക്കാറുണ്ട്.			
48.	പഠനകാര്യങ്ങൾ ചെയ്യുമ്പോൾ ആസൂത്രണത്തെക്കാളുപരി അവ സ്വന്തമായി ഏറ്റെടുത്ത് പൂർത്തീകരിക്കുകയാണ് ചെയ്യാറുള്ളത്.			
49.	എന്റെ കൂട്ടുകാരുമായി സംസാരിക്കുമ്പോൾ അവരോട് ചേർന്ന് നിന്ന് അവരെ തൊട്ടുകൊണ്ടാണ് സംസാരിക്കാറുള്ളത്.			
50.	പ്രയാസമേറിയ പഠനപ്രശ്നങ്ങൾ വേഗത്തിലും ലളിതമായും പരിഹരിക്കാൻ എനിക്ക് സാധിക്കാറില്ല.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
51.	കലാകായിക മത്സരങ്ങൾ നടത്താനും പങ്കെടുക്കാനും എനിക്ക് താൽപര്യമാണ്.			
52.	ചർച്ച, സംവാദം, സെമിനാർ തുടങ്ങിയ ക്ലാസ്റൂം പ്രവർത്തനങ്ങളിൽ ഞാൻ സജീവമായി പങ്കെടുക്കാറില്ല.			
53.	ഒരു സ്ഥലത്ത് ചടഞ്ഞിരുന്ന് പഠിക്കുന്നതിനേക്കാൾ പഠനമുറിയിൽ നടന്ന്കൊണ്ട് പഠിക്കാനാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
54.	ശാരീരിക പ്രവർത്തനങ്ങൾ ആവശ്യമുള്ള കാര്യങ്ങൾ വേഗത്തിലും പിഴവ് കൂടാതെയും ചെയ്തു തീർക്കാൻ എനിക്ക് കഴിയാറുണ്ട്.			
55.	പുതിയ ഒരു സാധനം വാങ്ങിക്കുമ്പോൾ ആദ്യം അതൊന്ന് പ്രവർത്തിപ്പിച്ച് നോക്കാറുണ്ട്.			
56.	മറ്റുള്ളവരുമായി ആശയവിനിമയം നടത്തുമ്പോൾ ആംഗ്യങ്ങളും ശരീരഭാഷയും ഞാൻ പരമാവധി ഉപയോഗിക്കാറുണ്ട്.			
57.	പഠനകാര്യങ്ങളെ ജീവിതാനുഭവങ്ങളുമായി ബന്ധപ്പെടുത്തി ഞാൻ ഓർത്ത് വെക്കാറുണ്ട്.			
58.	കാര്യങ്ങൾ ഓർക്കുമ്പോൾ വിരലുകൾ ഉപയോഗിച്ച് ടേബിളിലോ മറ്റു പ്രതലങ്ങളിലോ ഞാൻ എഴുതിനോക്കാറുണ്ട്.			
59.	വസ്തുക്കൾ നേരിട്ട് തൊട്ട് മനസ്സിലാക്കിയാണ് ഞാൻ പഠിക്കാറുള്ളത്.			
60.	പഠനത്തോടൊപ്പം ലഘുഭക്ഷണ പദാർത്ഥങ്ങൾ കഴിക്കുന്ന ശീലം എനിക്കുണ്ട്.			
61.	മറ്റുള്ളവരുമായി സംസാരിച്ച്കൊണ്ടിരിക്കുമ്പോൾ എന്റെ ശ്രദ്ധ ഞാൻ അറിയാതെ തെറ്റിപോകാറുണ്ട്.			
62.	വെറുതെ ബഹളം വെച്ച് മറ്റുള്ളവരെ ശല്യം ചെയ്യുന്ന സ്വഭാവം എനിക്കില്ല.			
63.	കാലാവസ്ഥയിലുണ്ടാകുന്ന ചെറിയ മാറ്റംപോലും എന്റെ പഠനകാര്യങ്ങളെ ബാധിക്കാറുണ്ട്.			
64.	മറ്റുള്ളവരുമായി സംസാരിക്കുകയാണെങ്കിലും എനിക്ക് എന്റെ കാര്യങ്ങൾ ചെയ്യാൻ സാധിക്കാറുണ്ട്.			
65.	കൂട്ടുകാരുടെ സങ്കടങ്ങളും സന്തോഷങ്ങളും മനസ്സിലാക്കിക്കൊണ്ടാണ് ഞാൻ അവരുമായി സംവദിക്കാറുള്ളത്.			
66.	ഏതൊരു പഠന പ്രവർത്തിയും കൂടുതൽ സമയം ചെയ്യേണ്ടി വരുമ്പോൾ ഞാൻ അസ്വസ്ഥനാകാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
67.	പഠിക്കുന്ന സമയത്ത് ഞാൻ ഡസ്കിൽ പേനയോ, നിലത്ത് കാൽപാദമോ ഉരസിക്കൊണ്ടിരിക്കാറുണ്ട്.			
68.	പഴയെ സുഹൃത്തുക്കളെ കാണുമ്പോൾ അവരെ കെട്ടപ്പിടി ക്കുകയോ ഹസ്തദാനം ചെയ്യുകയോ ആണ് ചെയ്യാറുള്ളത്.			
69.	ഒരു വാക്കിന്റെ ശരിയായ സ്പെല്ലിംഗ് ഓർക്കുന്നതിന് വേണ്ടി ഞാൻ അത് ഒരുപാട് തവണ പല രീതിയിൽ എഴതുകയും അതിൽ നിന്ന് ശരിയായ രീതി തിരഞ്ഞെടുക്കുകയും ചെയ്യും.			
70.	പുതിയ ഭാഷ പഠിക്കുന്നതിന് വേണ്ടി എഴുത്തും വായനയും അടങ്ങിയ വർക്കുബുക്കുകൾ ഉപയോഗിക്കുകയാണ് ഞാൻ ചെയ്യാറുള്ളത്.			
71.	എനിക്ക് ദേഷ്യം വരുമ്പോൾ ഞാൻ എന്റെ കൂട്ടുകാരെ ഉപദ്രവിക്കുകയാണ് ചെയ്യാറുള്ളത്.			
72.	പുതിയ വാക്കുകൾ പഠിക്കുന്നതിനു വേണ്ടി പ്ലാസ്റ്റിക് നിർമ്മിതമായ മാതൃകകൾ, മാഗ്നറ്റിക് ബോർഡുകൾ എന്നിവ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			
73.	ഒരാളെ കാണുമ്പോൾ ഞാൻ ആദ്യം ശ്രദ്ധിക്കുന്നത് അവ രുടെ നടത്തം, നൃത്തം എന്നിവയാണ്.			
74.	പഠനാവശ്യത്തിന് വേണ്ടി കമ്പ്യൂട്ടർ ബുദ്ധിമുട്ടു കൂടാതെ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			
75.	പുതിയ കാര്യങ്ങൾ മറ്റുള്ളവർക്ക് വിവരിച്ചുകൊടുക്കുമ്പോൾ ആദ്യം അവർക്കത് ചെയ്ത് കാണിച്ചുകൊടുക്കാറുണ്ട്.			

Appendix- C2

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

LEARNING STYLE INVENTORY
(Draft)

Dr. A. Hameed **Meharunnisa Karadan**
Assistant Professor Research Scholar

Name of the Student:..

Name of the School:.. Class:.............

Male/Female:.. Govt./Aided/Unaided

Instructions:

The statements given below are to identify your learning style. Three possible responses to each statement are provided – "Always", "Sometimes" and "Never". Read the statements carefully and tick (✓) the response found most suitable for you. The data provided by you will be kept confidential and used only for research purposes. Please ensure that you have marked your responses to all statements.

Sl. No.	Statements	Always	Sometimes	Never
1.	When operating a new equipment for the first time, I prefer to read the instructions.			
2.	I use visual aids like Blackboard and TV as learning aids.			
3.	I note down the points and ideas in notebooks or paper during the class.			
4.	I use maps, graphs and images to record ideas or points.			
5.	While I do exercises or learning activities mental images of the related lesson are formed.			
6.	I used to underline important point in the textbook or notebook using different colour pens.			

Sl. No.	Statements	Always	Sometimes	Never
7.	I occupy front seat in the class to get the teachers' gestures and expressions properly.			
8.	When I am frightened images of the related things come to my mind.			
9.	I find it difficult to follow longer classes			
10.	I have to stare at the teacher to understand what they say.			
11.	While thinking of others their faces come to my mind than their names.			
12.	I prefer ideas conceived by listening to those learned by seeing.			
13.	I am able to remember the spellings of words better as I visualize the letters as images.			
14.	I can understand the places and routes better when told than drawn.			
15.	While reading I will not be distracted by the noise in the surroundings.			
16.	I find it easy to understand matters through imagination.			
17.	I keep my books and clothes neatly and well arranged.			
18.	I write English and Malayalam neatly and beautifully.			
19.	I use short notes and pictures for revision during the exam time.			
20.	I am very much interested in visiting museums and galleries during my spare time.			
21.	I used to take a list of items prepared in advance for shopping.			
22.	When I am sad or in trouble, it will be reflects in the face at once.			
23.	Before buying a new product, I used to learn about it from print or visual media.			
24.	I remember the costumes and settings in films than other elements.			

Sl. No.	Statements	Always	Sometimes	Never
25.	I judge others based on their dressing and appearance.			
26.	I speak mostly of what I saw and about how things look like.			
27.	I mostly listened to music during free time.			
28.	I prefer reading the lessons aloud.			
29.	Sometimes I speak to myself when I learn			
30.	I usually sit in the front bench learning forward or straight.			
31.	I like to learn lessons listening to music			
32.	Inorder to imprint an idea I repeatedly say it aloud.			
33.	I cannot recognize persons through telephonic conversations.			
34.	I speak faster than others.			
35.	When I read textbooks I whisper with my lips silently.			
36.	I prefer verbal instructions than written instructions.			
37.	I used to record classes to listen later.			
38.	I move my head while listening to the classes.			
39.	I used to talk to the experts before using a new appliance or instrument.			
40.	My tone varies when I feel happy or sad.			
41.	When I travel along a unfamiliar route, I used enquire about the direction.			
42.	Teachers' verbal encouragements motivates me better than other modes of encouragement.			
43.	I remember dialogues, background music and sound than other elements in the films.			
44.	I don't keep notebooks and paper used for studies neatly.			
45.	I prefer learning by directly manipulating thing to learning by reading.			

Sl. No.	Statements	Always	Sometimes	Never
46.	I like classroom with various activities like physical involvement.			
47.	I take intervals and increase time while studying.			
48.	I like to execute learning activities personally than planning about it.			
49.	When I speak to friends, I stand closer and touch them.			
50.	I am unable to solve difficult learning problems quickly and easily.			
51.	I like organizing and participating arts and sports competitions.			
52.	I do not participate in discussions, debates, seminars etc. conducted in the classroom actively.			
53.	I prefer moving around the study room while studying than sitting in a place for long.			
54.	I can complete activities with physical involvement quickly and perfectly.			
55.	Before I buy a new device or instrument, I check its operation.			
56.	I make use of gestures and body language while communicating with others.			
57.	I try to remember learned concepts by connecting to life experiences.			
58.	While recalling anything I write on table or anywhere with fingers.			
59.	While I learn, I used to touch and feel things.			
60.	I am in the habit of having snacks and light food items while studying.			
61.	My attention diverts when I talk to others.			
62.	I want disturb others by making noises.			
63.	The slight changes in the climate effect my learning.			

Sl. No.	Statements	Always	Sometimes	Never
64.	I am able to do my works even if I am talking to others.			
65.	I interact with my friends by considering their happiness and sorrows.			
66.	I get upset when I have to spend a lot of time on a particular learning activity.			
67.	When I study, I used to scratch with my pen on the desk or scratch my feet on the floors.			
68.	When I met old friends I used to hug them or offer shake-hand.			
69.	In order to spell words correctly I write the word in different ways and select the right one.			
70.	To learn a new language I use workbooks with reading and writing activities.			
71.	I quarrel with my friends when I get angry			
72.	To learn new words I use plastic models and magnetic boards.			
73.	When I see a person I first notice how they walk or stand.			
74.	I use computers comfortably for learning purposes.			
75.	If I explain a new thing to others, I will work it out in front of them.			

Appendix- C3

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

LEARNING STYLE INVENTORY
(Final)

Dr. A. Hameed
Assistant Professor

Meharunnisa Karadan
Research Scholar

വിദ്യാർത്ഥിയുടെ പേര്:...

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:.............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

നിർദ്ദേശങ്ങൾ:

നിങ്ങളുടെ പഠനരീതി എങ്ങിനെയാണ് എന്നറിയുന്നതിനുള്ള ചില പ്രസ്താവനകളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ പ്രസ്താവനയ്ക്കും 'എല്ലായ്പ്പോഴും', 'ചിലപ്പോൾ മാത്രം', 'ഒരിക്കലുമില്ല' എന്നിങ്ങനെ മൂന്ന് പ്രതികരണങ്ങൾ നൽകിയിട്ടുണ്ട്. ഓരോ പ്രസ്താവനയും ശ്രദ്ധാപൂർവ്വം വായിച്ചതിന് ശേഷം നിങ്ങൾ ഏറ്റവും യോജിക്കന്നതിന്റെ നേരെ ശരി ചിഹ്നം '✓' രേഖപ്പെടുത്തുക. നിങ്ങൾ നൽകുന്ന വിവരം രഹസ്യമായി സൂക്ഷിക്കുന്നതും ഗവേഷണാവശ്യത്തിനുവേണ്ടി മാത്രം ഉപയോഗിക്കുന്നതുമാണ്. എല്ലാ പ്രസ്താവനകൾക്കും പ്രതികരണം രേഖപ്പെടുത്താൻ പ്രത്യേകം ശ്രദ്ധിക്കണം.

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
1.	ദൃശ്യമാധ്യമങ്ങളായ ബ്ലാക്ക്ബോർഡ്, ടെലിവിഷൻ എന്നിവ പഠനസാമഗ്രികളായി ഉപയോഗിക്കാറുണ്ട്.			
2.	ക്ലാസിനിടയ്ക്ക് ആശയങ്ങൾ നോട്ട്ബുക്കിലോ മറ്റേതെങ്കിലും രീതിയിലോ ഞാൻ വിശദമായി എഴുതി വെയ്ക്കാറുണ്ട്.			
3.	ഗ്രാഫ്, ഭൂപടം, ചിത്രങ്ങൾ എന്നിവ ഞാൻ ആശയങ്ങൾ രേഖപ്പെടുത്താൻ വേണ്ടി ഉപയോഗിക്കാറുണ്ട്.			
4.	പഠനാഭ്യാസങ്ങൾ പൂർത്തീകരിക്കുന്ന സമയത്ത് അതുമായി ബന്ധപ്പെട്ട പാഠപുസ്തകത്തിലെ പ്രസ്തുത ഭാഗത്തിന്റെ ചിത്രം എന്റെ മനസ്സിലേക്ക് വരാറുണ്ട്			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
5.	ടെക്സ്റ്റ് ബുക്ക്, നോട്ടുബുക്ക് എന്നിവയിലെ പ്രധാനപ്പെട്ട ആശയങ്ങൾ കളർപേന ഉപയോഗിച്ച് ഞാൻ അടിവരയിട്ട് വെയ്ക്കാറുണ്ട്.			
6.	അധ്യാപകർ ക്ലാസിൽ പറയുന്ന കാര്യം മനസ്സിലാകണമെങ്കിൽ എനിക്ക് അവരുടെ മുഖത്ത് നോക്കണം.			
7.	മറ്റുള്ളവരെക്കുറിച്ച് ആലോചിക്കുമ്പോൾ അവരുടെ പേരിനേക്കാളും അവരുടെ മുഖമാണ് എന്റെ ഓർമ്മയിൽ വരാറുള്ളത്.			
8.	ഓരോ വാക്കുകളിലേയും അക്ഷരങ്ങളെ ചിത്രങ്ങളായി കാണുന്നതുകൊണ്ട് എനിക്ക് അവയുടെ സ്പെല്ലിംഗ് കൂടുതൽ ഓർക്കാൻ കഴിയാറുണ്ട്.			
9.	എന്നെ സംബന്ധിച്ചിടത്തോളം കാര്യങ്ങൾ ഓർമ്മയിൽ ഉറപ്പിക്കുവാനുള്ള എളുപ്പമാർഗ്ഗം അവ ഭാവനയിൽ കാണുന്നതാണ്.			
10.	പുസ്തകങ്ങൾ, വസ്ത്രങ്ങൾ എന്നിവ പരമാവധി നല്ല രീതിയിൽ ഞാൻ ഒരുക്കി വെയ്ക്കാറുണ്ട്.			
11.	മലയാളം, ഇംഗ്ലീഷ് എന്നിവ നല്ല വൃത്തിയായും ഭംഗിയായും ഞാൻ എഴുതാറുണ്ട്.			
12.	പരീക്ഷാസമയങ്ങളിൽ പുനർവായനയ്ക്ക് ചെറിയ കുറിപ്പുകളും ചിത്രങ്ങളുമാണ് ഉപയോഗിക്കാറുള്ളത്.			
13.	ഒഴിവുസമയങ്ങളിൽ മ്യൂസിയങ്ങൾ, ഗാലറികൾ എന്നിവ സന്ദർശിക്കുന്നത് ഞാൻ ഏറെ ഇഷ്ടപ്പെടുന്നു.			
14.	പുതിയ ഒരു സാധനം വാങ്ങിക്കുന്നതിനു മുമ്പ് അതിനെക്കുറിച്ച് പത്രമാധ്യമങ്ങളിലൂടെയോ മറ്റോ മനസ്സിലാക്കാൻ ശ്രമിക്കാറുണ്ട്.			
15.	ഒഴിവുസമയങ്ങളിൽ അധികവും ഞാൻ പാട്ടു കേൾക്കുകയാണ് പതിവ്.			
16.	പാഠഭാഗങ്ങൾ ഉച്ചത്തിൽ ഉരുവിട്ട് പഠിക്കാനാണ് എനിക്കിഷ്ടം.			
17.	പഠനസമയങ്ങളിൽ ചിലപ്പോൾ ഞാൻ എന്നോട് തന്നെ സംസാരിക്കാറുണ്ട്.			
18.	സാധാരണയായി ക്ലാസിലെ മുൻബെഞ്ചിൽ നിവർന്നോ അല്ലെങ്കിൽ മുമ്പോട്ടാഞ്ഞോ ആണ് ഞാൻ ഇരിക്കാറുള്ളത്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
19.	പാഠഭാഗങ്ങൾ സംഗീതം കേട്ടുകൊണ്ടു പഠിക്കുന്നതാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
20.	പഠിച്ച ആശയങ്ങൾ മനസ്സിലുറപ്പിക്കുന്നതിനുവേണ്ടി ഞാൻ അവ ആവർത്തിച്ച് പറഞ്ഞു നോക്കാറുണ്ട്.			
21.	നേരിട്ടുള്ള സംസാരത്തിലൂടെയോ ഫോൺ സംഭാഷണത്തിലൂടെയോ എനിക്ക് വ്യക്തികളെ തിരിച്ചറിയാൻ കഴിയാറില്ല.			
22.	എന്റെ സംസാരത്തിന്റെ വേഗത മറ്റുള്ളവരേക്കാൾ കൂടുതലാണ്.			
23.	ഞാൻ ടെക്സ്റ്റ് ബുക്കുകൾ വായിച്ചുകൊണ്ടിരിക്കുമ്പോൾ ചുണ്ടുകൾ കൊണ്ട് ശബ്ദമില്ലാതെ മന്ത്രിക്കാറുണ്ട്.			
24.	എഴുതപ്പെട്ട നിർദ്ദേശങ്ങളേക്കാൾ വാക്കാലുള്ള നിർദ്ദേശങ്ങളാണ് എനിക്ക് താത്പര്യം.			
25.	പിന്നീട് കേൾക്കുന്നതിന് വേണ്ടി ഞാൻ ക്ലാസുകൾ റെക്കോർഡ് ചെയ്ത് വെക്കാറുണ്ട്.			
26.	ക്ലാസ്സിലിരുന്ന് പാഠഭാഗങ്ങൾ ശ്രദ്ധിക്കുന്ന സമയത്ത് ഞാൻ തലയാട്ടാറുണ്ട്.			
27.	പുതിയ ഉപകരണങ്ങൾ പ്രവർത്തിപ്പിക്കുന്നതിന് മുമ്പ് അതുപയോഗിച്ച് പരിചയമുള്ളവരുമായി സംസാരിക്കാറുണ്ട്.			
28.	സന്തോഷം, സങ്കടം എന്നീ വികാരങ്ങളുണ്ടാകുമ്പോൾ എന്റെ ശബ്ദത്തിൽ വ്യത്യാസം വരാറുണ്ട്.			
29.	അധ്യാപകരുടെ വാക്കാലുള്ള പ്രോത്സാഹനമാണ് മറ്റുള്ള രീതികളേക്കാൾ എന്നെ പഠനത്തിലേക്ക് നയിക്കാറുള്ളത്.			
30.	സിനിമകളിലെ ഡയലോഗ്, പശ്ചാത്തല സംഗീതം, ശബ്ദം എന്നിവയാണ് ഞാൻ കൂടുതൽ ഓർക്കാറുള്ളത്.			
31.	പഠനത്തിന് വേണ്ടി ഞാൻ ഉപയോഗിക്കാറുള്ള നോട്ട്ബുക്കുകൾ, പേപ്പറുകൾ എന്നിവ ഞാൻ വൃത്തിയായി സൂക്ഷിക്കാറില്ല.			
32.	വായിച്ച് പഠിക്കുന്നതിന് പകരം പാഠ്യവസ്തുക്കൾ നേരിട്ട് കൈകാര്യം ചെയ്തു പഠിക്കാനാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
33.	കലാകായിക മത്സരങ്ങൾ നടത്താനും പങ്കെടുക്കാനും എനിക്ക് താൽപര്യമാണ്.			
34.	ചർച്ച, സംവാദം, സെമിനാർ തുടങ്ങിയ ക്ലാസ്റൂം പ്രവർത്തനങ്ങളിൽ ഞാൻ സജീവമായി പങ്കെടുക്കാറില്ല.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
35.	ഒരു സ്ഥലത്ത് ചടഞ്ഞിരുന്ന് പഠിക്കുന്നതിനേക്കാൾ പഠനമുറിയിൽ നടന്ന്കൊണ്ട് പഠിക്കാനാണ് ഞാൻ ഇഷ്ടപ്പെടുന്നത്.			
36.	ശാരീരിക പ്രവർത്തനങ്ങൾ ആവശ്യമുള്ള കാര്യങ്ങൾ വേഗത്തിലും പിഴവ് കൂടാതെയും ചെയ്തു തീർക്കാൻ എനിക്ക് കഴിയാറുണ്ട്.			
37.	പുതിയ ഒരു സാധനം വാങ്ങിക്കുമ്പോൾ ആദ്യം അതൊന്ന് പ്രവർത്തിപ്പിച്ച് നോക്കാറുണ്ട്.			
38.	മറ്റുള്ളവരുമായി ആശയവിനിമയം നടത്തുമ്പോൾ ആംഗ്യങ്ങളും ശരീരഭാഷയും ഞാൻ പരമാവധി ഉപയോഗിക്കാറുണ്ട്.			
39.	പഠനകാര്യങ്ങളെ ജീവിതാനുഭവങ്ങളുമായി ബന്ധപ്പെടുത്തി ഞാൻ ഓർത്ത് വെക്കാറുണ്ട്.			
40.	വസ്തുക്കൾ നേരിട്ട് തൊട്ട് മനസ്സിലാക്കിയാണ് ഞാൻ പഠിക്കാറുള്ളത്.			
41.	പഠനത്തോടൊപ്പം ലഘുഭക്ഷണ പദാർത്ഥങ്ങൾ കഴിക്കുന്ന ശീലം എനിക്കുണ്ട്.			
42.	മറ്റുള്ളവരുമായി സംസാരിച്ച്കൊണ്ടിരിക്കുമ്പോൾ എന്റെ ശ്രദ്ധ ഞാൻ അറിയാതെ തെറ്റിപോകാറുണ്ട്.			
43.	കാലാവസ്ഥയിലുണ്ടാകുന്ന ചെറിയ മാറ്റംപോലും എന്റെ പഠനകാര്യങ്ങളെ ബാധിക്കാറുണ്ട്.			
44.	മറ്റുള്ളവരുമായി സംസാരിക്കുകയാണെങ്കിലും എനിക്ക് എന്റെ കാര്യങ്ങൾ ചെയ്യാൻ സാധിക്കാറുണ്ട്.			
45.	കൂട്ടുകാരുടെ സങ്കടങ്ങളും സന്തോഷങ്ങളും മനസ്സിലാക്കിക്കൊണ്ടാണ് ഞാൻ അവരുമായി സംവദിക്കാറുള്ളത്.			
46.	പഴയെ സുഹൃത്തുക്കളെ കാണുമ്പോൾ അവരെ കെട്ടപ്പിടിക്കുകയോ ഹസ്തദാനം ചെയ്യുകയോ ആണ് ചെയ്യാറുള്ളത്.			
47.	ഒരു വാക്കിന്റെ ശരിയായ സ്പെല്ലിംഗ് ഓർക്കുന്നതിന് വേണ്ടി ഞാൻ അത് ഒരുപാട് തവണ പല രീതിയിൽ എഴതുകയും അതിൽ നിന്ന് ശരിയായ രീതി തിരഞ്ഞെടുക്കുകയും ചെയ്യും.			
48.	എനിക്ക് ദേഷ്യം വരുമ്പോൾ ഞാൻ എന്റെ കൂട്ടുകാരെ ഉപദ്രവിക്കുകയാണ് ചെയ്യാറുള്ളത്.			
49.	പുതിയ വാക്കുകൾ പഠിക്കുന്നതിനു വേണ്ടി പ്ലാസ്റ്റിക് നിർമ്മിതമായ മാതൃകകൾ, മാഗ്നറ്റിക് ബോർഡുകൾ എന്നിവ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			

ക്രമ നമ്പർ	പ്രസ്താവനകൾ	എല്ലായ്പ്പോഴും	ചിലപ്പോൾ മാത്രം	ഒരിക്കലുമില്ല
50.	ഒരാളെ കാണുമ്പോൾ ഞാൻ ആദ്യം ശ്രദ്ധിക്കുന്നത് അവരുടെ നടത്തം, നൃത്തം എന്നിവയാണ്.			
51.	പഠനാവശ്യത്തിന് വേണ്ടി കമ്പ്യൂട്ടർ ബുദ്ധിമുട്ടു കൂടാതെ ഞാൻ ഉപയോഗിക്കാറുണ്ട്.			
52.	പുതിയ കാര്യങ്ങൾ മറ്റുള്ളവർക്ക് വിവരിച്ചുകൊടുക്കുമ്പോൾ ആദ്യം അവർക്കത് ചെയ്ത് കാണിച്ചുകൊടുക്കാറുണ്ട്.			

Appendix- C4

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

LEARNING STYLE INVENTORY
(Final)

Dr. A. Hameed — **Meharunnisa Karadan**
Assistant Professor — Research Scholar

Name of the Student:...

Name of the School:.. Class:.............

Male/Female:... Govt./Aided/Unaided

Instructions:

The statements given below are to identify your learning style. Three possible responses to each statement are provided – "Always", "Sometimes" and "Never". Read the statements carefully and tick (✓) the response found most suitable for you. The data provided by you will be kept confidential and used only for research purposes. Please ensure that you have marked your responses to all statements.

Sl. No.	Statements	Always	Sometimes	Never
1.	I use visual aids like Blackboard and TV as learning aids.			
2.	I note down the points and ideas in notebooks or paper during the class.			
3.	I use maps, graphs and images to record ideas or points.			
4.	While I do exercises or learning activities mental images of the related lesson are formed.			
5.	I used to underline important point in the textbook or notebook using different colour pens.			

Sl. No.	Statements	Always	Sometimes	Never
6.	I have to stare at the teacher to understand what they say.			
7.	While thinking of others their faces come to my mind than their names.			
8.	I am able to remember the spellings of words better as I visualize the letters as images.			
9.	I find it easy to understand matters through imagination.			
10.	I keep my books and clothes neatly and well arranged.			
11.	I write English and Malayalam neatly and beautifully.			
12.	I use short notes and pictures for revision during the exam time.			
13.	I am very much interested in visiting museums and galleries during my spare time.			
14.	Before buying a new product, I used to learn about it from print or visual media.			
15.	I mostly listed to music during free time.			
16.	I prefer reading the lessons aloud.			
17.	Sometimes I speak to myself when I learn			
18.	I usually sit in the front bench learning forward or straight.			
19.	I like to learn lessons listening to music			
20.	Inorder to imprint an idea I repeatedly say it aloud.			
21.	I cannot recognize persons through telephonic conversations.			
22.	I speak faster than others.			
23.	When I read textbooks I whisper with my lips silently.			
24.	I prefer verbal instructions than written instructions.			
25.	I used to record classes to listen later.			
26.	I move my head while listening to the classes.			

Sl. No.	Statements	Always	Sometimes	Never
27.	I used to talk to the experts before using a new appliance or instrument.			
28.	My tone varies when I feel happy or sad.			
29.	Teachers' verbal encouragements motivates me better than other modes of encouragement.			
30.	I remember dialogues, background music and sound than other elements in the films.			
31.	I don't keep notebooks and paper used for studies neatly.			
32.	I prefer learning by directly manipulating thing to learning by reading.			
33.	I like organizing and participating arts and sports competitions.			
34.	I do not participate in discussions, debates, seminars etc. conducted in the classroom actively.			
35.	I prefer moving around the study room while studying than sitting in a place for long.			
36.	I can complete activities with physical involvement quickly and perfectly.			
37.	Before I buy a new device or instrument, I check its operation.			
38.	I make use of gestures and body language while communicating with others.			
39.	I try to remember learned concepts by connecting to life experiences.			
40.	While I learn, I used to touch and feel things.			
41.	I am in the habit of having snacks and light food items while studying.			
42.	My attention diverts when I talk to others.			
43.	The slight changes in the climate effect my learning.			
44.	I am able to do my works even if I am talking to others.			

Sl. No.	Statements	Always	Sometimes	Never
45.	I interact with my friends by considering their happiness and sorrows.			
46.	When I met old friends I used to hug them or offer shake-hand.			
47.	In order to spell words correctly I write the word in different ways and select the right one.			
48.	I quarrel with my friends when I get angry			
49.	To learn new words I use plastic models and magnetic boards.			
50.	When I see a person I first notice how they walk or stand.			
51.	I use computers comfortably for learning purposes.			
52.	If I explain a new thing to others, I will work it out in front of them.			

Appendix- D1

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY

(Draft)

Dr. A. Hameed | **Meharunnisa Karadan**
Assistant Professor | Research Scholar

നിർദ്ദേശങ്ങൾ:

രസതന്ത്രത്തിലെ പ്രക്രിയാനൈപുണികൾ അളക്കുന്നതിനുള്ള ഒരു പരീക്ഷയാണിത്. ഓരോ ചോദ്യത്തിനും നേരെ a, b, c, d എന്നിങ്ങനെ അക്ഷരങ്ങളിട്ട് നാല് ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ നിന്നും ശരിയുത്തരം കണ്ടുപിടിച്ച് ഉത്തരക്കടലാസിൽ ചോദ്യത്തിനു നേരെ കൊടുത്തിട്ടുള്ള ബോക്സിൽ രേഖപ്പെടുത്തുക. പരമാവധി ചുരുങ്ങിയ സമയത്തിനുള്ളിൽ ചോദ്യങ്ങൾക്ക് ഉത്തരം രേഖപ്പെടുത്തണം. ചോദ്യപേപ്പറിൽ ഒന്നും എഴുതുകയോ വരയ്ക്കുകയോ ചെയ്യരുത്

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1. താഴെ കൊടുത്തിരിക്കുന്ന മൂലകങ്ങളിൽ ഏറ്റവും കൂടുതൽ സ്ഥിരത ഏതിനാണ്?
   a. നൈട്രജൻ
   b. ഓക്സിജൻ
   c. ഫ്ളൂറിൻ
   d. നിയോൺ
2. ഏറ്റവും കൂടുതൽ ആറ്റം ഉള്ള സംയുക്തം ഏത്?
   a. H_2S
   b. NaCl
   c. 2 MgO
   d. 4 HCl
3. ശരിയായ ബന്ധം ഏതെന്ന് കണ്ടെത്തുക.

1. പ്രോട്ടോൺ	A. ബോർ
2. ഇലക്ട്രോൺ	B. ജെ.ജെ. തോംസൺ
3. ന്യൂട്രോൺ	C. റൂഥർഫോർഡ്
4. ഓർബിറ്റൽ	D. ചാഡ്വിക്

   a. 1-B, 2-C, 3-A, 4-D
   b. 1-C, 2-B, 3-D, 4-A
   c. 1-D, 2-A, 3-C, 4-B
   d. 1-A, 2-D, 3-B, 4-C
4. ഞാൻ ഒരു മൂലകമാണ്. ജോസഫ് പ്രീസ്റ്റിലിയാണ് എന്നെ ആദ്യമായി നിർമ്മിച്ചത്. മെർക്കുറിക് ഓക്സൈഡ് ചൂടാക്കുമ്പോൾ ഞാനുണ്ടാകുന്നുണ്ട്. എന്താണ് എന്റെ പ്രതീകം?
   a. H
   b. O
   c. N
   d. F

5. ആധുനിക പിരിയോഡിക് ടേബിളിലിൽ മൂലകങ്ങൾ ക്രമീകരിച്ചിരിക്കുന്നത്

   a. ആറ്റോമിക നമ്പറിന്റെ അടിസ്ഥാനത്തിൽ
   b. ആറ്റോമിക മാസിന്റെ അടിസ്ഥാനത്തിൽ
   c. ലോഹസ്വഭാവത്തിന്റെ അടിസ്ഥാനത്തിൽ
   d. വലിപ്പത്തിന്റെ അടിസ്ഥാനത്തിൽ

6. താഴെ കൊടുത്തിരിക്കുന്ന ഗ്രൂപ്പുകളിൽ നിന്നും കൂട്ടത്തിൽ ചേരാത്തതിനെ കണ്ടെത്തുക.

   a. പിരിയോഡ്
   b. ഗ്രൂപ്പ്
   c. പ്രതീകങ്ങൾ
   d. ഓർബിറ്റുകൾ

7. ഒരേ ഗ്രൂപ്പിൽ വരുന്ന മൂലകങ്ങൾ സമാന ഗുണങ്ങൾ ആവർത്തിക്കാനുള്ള കാരണം എന്തായിരിക്കും?

   a. രാസഗുണങ്ങൾ സമാനമായതിനാൽ
   b. ഭൗതികഗുണങ്ങൾ സമാനമായതിനാൽ
   c. വാലൻസ് ഇലക്ട്രോണുകളുടെ എണ്ണം സമാനമായതിനാൽ
   d. ആറ്റോമിക നമ്പർ സമാനമായതിനാൽ

8. $2\,Na + Cl_2 \rightarrow 2\,NaCl$

   $2\,Mg + O_2 \rightarrow 2\,MgO$

   മുകളിലെ രാസ പ്രവർത്തനങ്ങളിൽ അഭികാരകങ്ങളെ കാണിക്കുന്ന ശരിയായ ഗ്രൂപ്പ് ഏത്?

   a. Na, Cl, Mg, O
   b. NaCl, Na, Mg, O
   c. MgO, Mg, Na, Cl
   d. NaCl, MgO, Cl, O

9. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ സൾഫ്യൂരിക് ആസിഡിന്റെ രാസവാക്യം ഏത്?

   a. HCl
   b. HNO_3
   c. H_2SO_4
   d. H_3SO_4

10. നിങ്ങൾ ചുറ്റുപാടുകൾ നിരീക്ഷിച്ചതിൽ നിന്നും താഴെ കൊടുത്തരിക്കുന്നവയിൽ രാസമാറ്റം ഏത്?

    a. മെഗ്നീഷ്യം കത്തുന്നു
    b. മെഴുക് ഉരുകുന്നു
    c. ജലം നീരാവിയാകുന്നു
    d. ഐസ് ഉരുകുന്നു

11. ദ്രവ്യത്തിന്റെ വിവിധ അവസ്ഥകളുമായി ബന്ധപ്പെട്ട പ്രസ്താവനകൾ കൊടുത്തിരി ക്കുന്നു. ഇവയിൽ ഏതാണ് തെറ്റ്?

    a. ഖരം ദ്രാവകമാകുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള അകലം കൂടുന്നു.
    b. വാതകം ദ്രാവകമായി മാറുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള ആകർഷണബലം കൂടുന്നു.
    c. ദ്രാവകം ഖരമായി മാറുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള അകലം കൂടുന്നു.
    d. വാതകങ്ങളുടെ വ്യാപ്തം, അതു സ്ഥിതി ചെയ്യുന്ന പാത്രത്തിന്റെ വ്യാപ്തത്തിന് തുല്യമാകും.

12. വേനൽകാലത്ത് കറുപ്പ് വസ്ത്രം ധരിച്ചാൽ കൂടുതൽ ചൂട് അനുഭവപ്പെടുന്നു. ഇതിന് കാരണം എന്തായിരിക്കും?

    a. കറുപ്പ് എല്ലാ നിറങ്ങളും പ്രതിഫലിപ്പിക്കുന്നു.
    b. കറുപ്പ് സൂര്യപ്രകാശത്തിലെ എല്ലാ നിറങ്ങളെയും ആഗിരണം ചെയ്യുന്നു.
    c. കറുപ്പ് കൂടുതൽ ചൂട് ഉത്പാദിപ്പിക്കുന്നു.
    d. കറുപ്പിന് ചൂടിനെ ആഗിരണം ചെയ്യാനുള്ള ശേഷി വളരെ കുറവാണ്.

13. താഴെ കൊടുത്തിരിക്കുന്ന ഗ്രൂപ്പുകളിൽ നിന്നും കൂട്ടത്തിൽ ചേരാത്തതിനെ കണ്ടെത്തുക.

    a. ലാവോസിയ
    b. ഡൊബൈറെനർ
    c. മെൻഡലിയേഫ്
    d. ഡാൽട്ടൻ

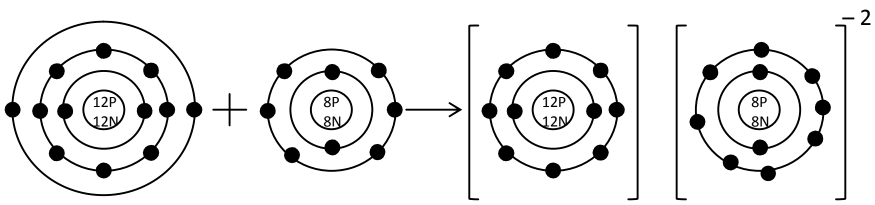
14. കടൽ പ്രദേശങ്ങളിലുള്ള വീടുകളിലെ ജനൽ കമ്പികൾ മറ്റ് പ്രദേശങ്ങളിലേക്കാൾ പെട്ടെന്ന് തുരുമ്പിക്കുന്നതായി കാണപ്പെടുന്നു. ഇതിന്റെ കാരണം എന്താവാം?

    a. കടൽ പ്രദേശങ്ങളിൽ ആർദ്രത കൂടുതലായത്കൊണ്ട്
    b. കടൽ പ്രദേശങ്ങളിൽ ആർദ്രത കുറവായത്കൊണ്ട്
    c. ഇരുമ്പിന്റെ ഗുണനിലവാരം കുറവായത്കൊണ്ട്
    d. അശുദ്ധപദാർത്ഥങ്ങൾ കുടുതലായത്കൊണ്ട്.

15. ആറ്റം മാതൃകയെ സൗരയൂഥവുമായി താരതമ്യം ചെയ്ത് നിരീക്ഷിച്ചാൽ സൂര്യന് സമാനമായ ആറ്റത്തിലെ ഭാഗം ഏത്?

    a. ഷെൽ
    b. ഇലക്ട്രോൺ
    c. ന്യൂക്ലിയസ്
    d. പ്രോട്ടോൺ

16. മഗ്നീഷ്യം ഓക്സിജനുമായി ചേർന്ന് മഗ്നീഷ്യം ഓക്സൈഡ് ഉണ്ടാകുന്നതിന്റെ ബോർ മാതൃകയാണ് കാണിച്ചിരിക്കുന്നത്. ഇത് നിരീക്ഷിച്ച് താഴെ തന്നിരിക്കുന്ന ചോദ്യത്തിന് ഉത്തരം നൽകുക.



മുകളിലെ ചിത്രത്തിൽ മഗ്നീഷ്യത്തിന്റെ ചാർജ്ജ് എത്ര?

a. +2

b. −2

c. +1

d. −1

17. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ദ്രാവകാവസ്ഥയിലുള്ള ലോഹം ഏത്?

a. മെർക്കുറി

b. സിങ്ക്

c. സൾഫർ

d. അലുമിനിയം

18. ബൾബുകളുടെ ഫിലമെന്റ് നിർമ്മിച്ചിരിക്കുന്ന ലോഹം ഏത്?

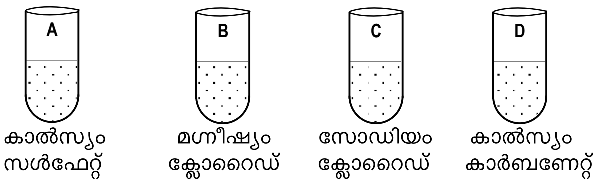
a. വെള്ളി

b. ഓസ്മിയം

c. ചെമ്പ്

d. ടങ്സ്റ്റൺ

വിവിധ പദാർത്ഥങ്ങൾ കലർന്ന ലായനികൾ നാല് ടെസ്റ്റ്യൂബുകളിലായി തന്നിരിക്കുന്നു. ഇത് നിരീക്ഷിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന രണ്ട് ചോദ്യങ്ങൾക്ക് ഉത്തരം എഴുതുക?



19. ഏത് ടെസ്റ്റ്യൂബിലെ ലായനിയിലാണ് തിളപ്പിച്ചാൽ മാറുന്ന കാഠിന്യം ഉള്ളത്?

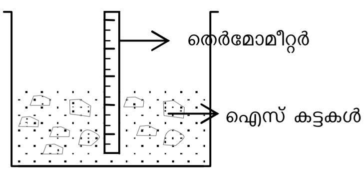
a. A

b. B

c. C

d. D

ഒരു ബീക്കറിൽ ഐസ് കട്ടകളെടുത്ത് അതിൽ ഒരു തെർമോമീറ്റർ സാധാരണ ഊഷ്മാവിൽ വച്ചിരിക്കുന്ന ചിത്രം കാണിച്ചിരിക്കുന്നു.



20. മുകളിലെ ചിത്രത്തിൽ ഐസിനുണ്ടാകുന്ന അവസ്ഥാമാറ്റം എന്ത്?

a. ഉരുകുന്നു

b. ഉരുകുന്നില്ല

c. ചൂടാക്കുമ്പോൾ ഉരുകുന്നു

d. ഇതൊന്നുമല്ല

21. ലബോറട്ടറിയിൽ ലീനടീച്ചർ നിങ്ങൾക്ക് കുറച്ച് പഞ്ചസാരയും ഒരു ബീക്കറിൽ ജലവും തന്നു. എന്നിട്ട് നിങ്ങളോട് പഞ്ചസാരവെള്ളം നിർമ്മിക്കുവാൻ ആവശ്യപ്പെടുന്നു. ഈ പദാർത്ഥത്തിലെ ലീനം ഏത്?

   a. പഞ്ചസാര
   b. വെള്ളം
   c. ലയിക്കുന്നില്ല
   d. ചൂടാക്കുമ്പോൾ മാത്രം ലയിക്കുന്നു

$\boxed{{}_{14}Si^{28}}$

സിലിക്കൺ എന്ന മൂലകത്തിന്റെ പിരിയോഡിക് ടേബിളിലെ ചിത്രീകരണം ആണ് കാണിച്ചിരിക്കുന്നത്. ഇതിൽ നിന്നും ആ മൂലകത്തിന്റെ താഴെ പറയുന്ന പ്രത്യേകതകൾ എഴുതുക.

22. പ്രതീകം എന്ത്?

   a. Ti
   b. V
   c. Si
   d. S

23. ആറ്റോമിക നമ്പർ എത്ര?

   a. 7
   b. 14
   c. 12
   d. 28

24. മാസ് നമ്പർ എത്ര?

   a. 7
   b. 12
   c. 14
   d. 28

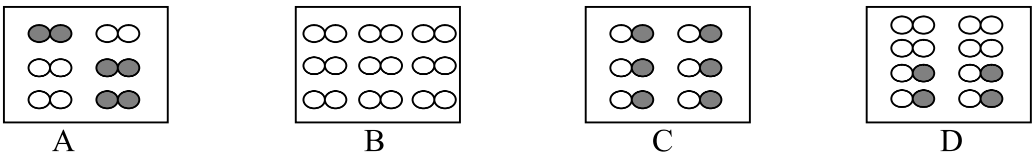
25. പൊട്ടാസ്യത്തിന്റെ ഇലക്ട്രോൺ ക്രമീകരണം 2, 8, 8, 1ഉം, കാൽസ്യത്തിന്റെ ഇലക്ട്രോൺ ക്രമീകരികരണം 2, 8, 8, 2 എന്നും ആണ്. ഏതിലാണ് കുറഞ്ഞ എണ്ണം ആറ്റം ഉള്ളത്?

   a. Ca
   b. Mg
   c. Na
   d. K

26. സോഡിയത്തിന്റെ ആറ്റോമിക നമ്പർ 11 ഉം മാസ് നമ്പർ 23 ഉം ആണെങ്കിൽ സോഡിയത്തിൽ അടങ്ങിയിട്ടുള്ള ന്യൂട്രോണുകളുടെ എണ്ണം കണ്ടുപിടിക്കുക.

   a. 13
   b. 11
   c. 12
   d. 23

27. ചില മൂലകങ്ങളുടെ ഇലക്ട്രോൺ വിന്യാസം തന്നിരിക്കുന്നു. ഇവയിൽ ഏറ്റവും വലിയ ആറ്റമുള്ള മൂലകം ഏത്?
    a. 2
    b. 2, 8
    c. 2, 8, 2
    d. 2, 8, 8, 2
28. ആസിഡുമായി പ്രവർത്തിച്ച് ഹൈഡ്രജൻ തരുന്ന മൂലകം കണ്ടെത്തുക.
    a. സോഡിയം
    b. കാൽസ്യം
    c. ബേരിയം
    d. ക്രോമിയം
29. തണുപ്പ് കൂടുതലുള്ള പ്രദേശങ്ങളിൽ റോഡുകളിൽ ഉപ്പ് വിതറുന്നത് നിങ്ങൾ ശ്രദ്ധിച്ചിട്ടില്ലേ? ഇതിന്റെ കാരണം എന്തായിരിക്കും?
    a. ഉപ്പ് ഐസ് ഉരുകുന്നതിന്റെ വേഗത കൂട്ടുന്നു.
    b. ഉപ്പ് ഐസിന്റെ പ്രതലബലം കൂട്ടുന്നു.
    c. ഉപ്പിന് ഐസിനേക്കാൾ സാന്ദ്രത കൂടുതലാണ്
    d. ഐസിന് ഉപ്പിനേക്കാൾ ഗാഢത കൂടുതലാണ്
30. വിനാഗിരിയുടെ pH 5ഉം മഴവെള്ളത്തിന്റെ pH 6ഉം ആണെന്ന് തന്നിരിക്കുന്നു. താഴെ കൊടു ത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ഇതിന് ഏറ്റവും അനുയോജ്യമായ വിശദീകരണം ഏത്?
    a. രണ്ടും ബേസുകളാണ്, വിനാഗിരിയാണ് കൂടുതൽ ബേസിക്
    b. രണ്ടും ആസിഡുകളാണ്, വിനാഗിരിയാണ് കൂടുതൽ അസിഡിക്
    c. രണ്ടും ബേസുകളാണ്, മഴവെള്ളമാണ് കൂടുതൽ ബേസിക്
    d. രണ്ടും ആസിഡുകളാണ്, മഴവെള്ളമാണ് കൂടുതൽ അസിഡിക്
31. താഴെ കൊടുത്തിരിക്കുന്ന ചിത്രങ്ങളിൽ ശുദ്ധപദാർത്ഥത്തെ സൂചിപ്പിക്കുന്ന ചിത്രം ഏത്?



    a. ചിത്രം A
    b. ചിത്രം B
    c. ചിത്രം C
    d. ചിത്രം D
32. ഓക്സിജന്റെ ആറ്റോമിക നമ്പർ '8' ആണ്. ഇതിന്റെ ശരിയായ ഇലക്ട്രോൺ ക്രമീകരണം സൂചിപ്പിക്കുന്ന വിധം ഏത്?
    a. 2, 5
    b. 2, 6
    c. 2, 5, 1
    d. 2, 4, 1

33. 'A' എന്ന മൂലകത്തിന്റെ ഇലക്ട്രോൺ വിന്യാസം $1s^2\ 2s^2\ 2p^6\ 3s^2$ എന്നാണ്. മൂലക ത്തിന്റെ ആറ്റോമിക നമ്പർ എത്ര?

a. 14	c. 10
b. 12	d. 13

34. ചില മിശ്രിതങ്ങളും അവയെ വേർതിരിക്കുന്നതിനുള്ള ചില ഉപകരണങ്ങളും നൽകി യിരിക്കുന്നു. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ നിന്ന് ഉചിതമായ ബന്ധം കണ്ടെത്തുക.

1. പാലിൽ നിന്നും ക്രീം	a. സെപറേറ്റിംഗ് ഫണൽ
2. സ്കെച്ച് പേനയിലെ കറുത്ത മഷി	b. സെൻട്രിഫ്യൂജ്
3. വെള്ളവും മണ്ണെണ്ണയും	c. ക്രൊമാറ്റോഗ്രാഫി
4. മണ്ണ് കലക്കിയ വെള്ളം	d. ഫിൽട്ടർ പേപ്പർ

a. 1-c, 2-a, 3-b, 4-d
b. 1-b, 2-c, 3-a, 4-d
c. 1-a, 2-c, 3-a, 4-a
d. 1-d, 2-b, 3-d, 4-c

35. ഒരു ഗ്ലാസ് സ്ലൈഡ് ജലത്തിൽ മുക്കിയാൽ ഗ്ലാസിൽ ജലം പറ്റിപ്പിടിക്കുന്നു. എന്നാൽ മെർക്കുറിയിലാണ് ഗ്ലാസ് സ്ലൈഡ് മുക്കിയതെങ്കിൽ ജലം പറ്റിപ്പിടിക്കുന്നില്ല. കാരണം എന്ത്?

a. അഡിഷൻ ബലം കാരണം
b. കൊഹിഷൻ ബലം കാരണം
c. പ്രതലബലം മൂലം
d. വിസ്കസ് ബലം കുറവായത്കൊണ്ട്

36. നീതുവിന് സയൻസ് ലാബിൽ നിന്ന് രണ്ട് ലവണങ്ങൾ ടീച്ചർ നൽകി. ഓരോന്നിലും ഗാഢ HCl ചേർത്ത കുഴമ്പ് രൂപത്തിലാക്കി, അല്പം എടുത്ത് ത്വീജ്വാലയിൽ കാണിച്ച പ്പോൾ ഒന്ന് ചുടുകട്ടയുടെ നിറവും മറ്റൊന്ന് ഇളം പച്ച നിറവും കാണിച്ചു. ലവണങ്ങൾ ഏവ?

a. Ca, Ba
b. Sr, Br
c. Na, Ca
d. K, Na

37. 'X'എന്ന മൂലകം (ഇലക്ട്രോൺ ക്രമീകരണം 2,8,1), 'Y' എന്ന മൂലകം (ഇലക്ട്രോൺ ക്രമീകരണം 2,8,7) സംയോജിച്ച് 'XY' എന്ന സംയുക്തം ഉണ്ടാകുന്നു. ഈ സംയുക്ത ത്തിൽ ഉണ്ടാകുന്നത് ഏത് തരം രാസബന്ധനം ആണ്?

a. ലോഹീയ ബന്ധനം
b. അയോണിക ബന്ധനം
c. സംയുക്ത ബന്ധനം
d. സഹസംയോജക ബന്ധനം

38. ഹൈഡ്രജൻ, നൈട്രജൻ എന്നിവ പ്രതിപ്രവർത്തിച്ച് അമോണിയ ഉണ്ടാകുന്നു. ഇത് രസതന്ത്രഭാഷയിൽ എങ്ങിനെ എഴുതാം?

   a. $N + 3H \rightarrow NH_3$
   b. $N+3H_3 \rightarrow NH_3$
   c. $2N_2 + 2H_2 \rightarrow 2NH_3$
   d. $N_2 + 3H_2 \rightarrow 2NH_3$

39. ഒരു ലായനിയുടെ pH മൂല്യം 4 ആണ്. താഴെ പറയുന്നതിൽ ഏത് സ്വഭാവമായിരിക്കും ലായനി കാണിക്കുക?

   a. അസിഡിക്
   b. ആൽക്കലൈൻ
   c. ന്യൂട്രൽ
   d. ജലം

40. ഒരു ആറ്റത്തിന്റെ നാലാമത്തെ ഷെല്ലിൽ ഉൾക്കൊള്ളാവുന്ന പരമാവധി ഇലക്ട്രോണുകളുടെ എണ്ണം എത്ര?

   a. 31
   b. 32
   c. 33
   d. 35

<u>'A' എന്ന മൂലകത്തിന്റെ ആറ്റത്തിന് മൂന്ന് ഷെല്ലുകൾ ഉണ്ട്. അതിന്റെ മൂന്നാമത്തെ ഷെല്ലിൽ 4 ഇലക്ട്രോണുകൾ ഉണ്ട് എങ്കിൽ</u>

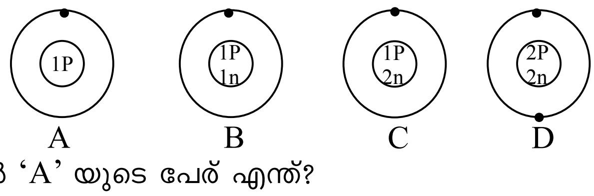
41. 'A' യുടെ ആറ്റോമിക നമ്പർ എത്ര?

   a. 14
   b. 13
   c. 15
   d. 16

42. ഇലക്ട്രോണുകളുടെ എണ്ണം എത്ര?

   a. 14
   b. 13
   c. 15
   d. 16

<u>ഹൈഡ്രജൻ പ്രകൃതിയിൽ കണ്ടുവരുന്ന വ്യത്യസ്ത രൂപങ്ങൾ ചിത്രീകരിച്ചിരിക്കുന്നു.</u>



43. ഇതിൽ 'A' യുടെ പേര് എന്ത്?

   a. പ്രോട്ടിയം
   b. ഡ്യൂട്ടീരിയം
   c. ട്രിഷിയം
   d. ഇതൊന്നുമല്ല

44. താഴെ കൊടുത്തിരിക്കുന്ന മൂലക ആറ്റങ്ങളുടെ ചുരുക്കെഴുത്തുകൾ പരിശോധിച്ച് ഐസോബാർ ഏതാണെന്ന് കണ്ടെത്തുക?

I	II	III	IV	V
$^{40}_{18}A$	$^{35}_{17}B$	$^{40}_{20}C$	$^{36}_{17}D$	$^{23}_{11}E$

a. I & II
b. I & III
c. II & III
d. I & V

CH_4 തന്മാത്രയിൽ അടങ്ങയിരിക്കുന്ന

45. കാർബൺ ആറ്റങ്ങളുടെ എണ്ണം എത്ര?

a. 2
b. 1
c. 4
d. 5

46. ഹൈഡ്രജൻ ആറ്റങ്ങളുടെ എണ്ണം എത്ര?

a. 4
b. 5
c. 1
d. 2

47. ആകെ ആറ്റങ്ങളുടെ എണ്ണം എത്ര?

a. 5
b. 6
c. 1
d. 4

48. താഴെ കൊടുത്തിരിക്കുന്നതിൽ ബഹു ആറ്റോമിക തന്മാത്ര ഏതാണെന്ന് കാണ്ടെത്തുക?

a. S_8
b. Na
c. P_4
d. O_2

49. ചില മൂലകങ്ങളുടെ ഇലക്ട്രോൺ വിന്യാസം താഴെ നൽകിയിരിക്കുന്നു.

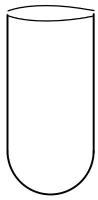
മൂലകം A- 2, 8, 8 മൂലകം C- 2, 8

മൂലകം B- 2, 8, 1 മൂലകം D- 2

ഇവയിൽ രാസപ്രവർത്തനത്തിൽ ഏർപ്പെടാൻ സാധ്യതയുള്ള മൂലകം ഏതായിരിക്കും?

a. മൂലകം A
b. മൂലകം B
c. മൂലകം C
d. മൂലകം D

50. ചിത്രത്തിൽ കാണിച്ചിരിക്കുന്ന ഉപകരണത്തിന് പറയുന്ന പേരെന്ത്?



a. ടെസ്റ്റ്യൂബ്

b. ബീക്കർ

c. തിസിൽ ഫണൽ

d. ഗ്ലാസ്റോഡ്

51. പ്രതലബലം ദ്രാവകങ്ങളുടെ പ്രതലങ്ങളെ ചുരുങ്ങുന്നതിനാണോ വികസിക്കുന്നതിനാണോ പ്രേരിപ്പിക്കുന്നത്?

a. ചുരുങ്ങുവാൻ

b. വികസിക്കുവാൻ

c. സ്ഥിരാവസ്ഥയിൽ തുടരുവാൻ

d. ഇതൊന്നുമല്ല

52. തന്നിരിക്കുന്ന മിശ്രിതങ്ങൾക്കുനെരേ അവയ്ക്ക് അനുയോജ്യമായ ഘടകങ്ങളെ വേർതിരിക്കുന്ന മാർഗ്ഗം എതെന്ന് കണ്ടെത്തുക.

1.	അസറ്റോണും ജലവും	:	A. അശികസ്വേദനം
2.	ഉപ്പ് വെള്ളം	:	B. സ്വേദനം
3.	ചെളിവെള്ളം	:	C. ബാഷ്പീകരണം
4.	മെഥനോളും എഥനോളും	:	D. അരിക്കൽ

a. 1-c, 2-a, 3-b, 4-d

b. 1-c, 2-b, 3-d, 4-a

c. 1-a, 2-c, 3-a, 4-a

d. 1-d, 2-b, 3-d, 4-c

53. ചിത്രത്തിൽ കാണിച്ചിരിക്കുന്ന ഉപകരണം ഏതാണ്?

a. സെൻട്രിഫ്യൂജ്

b. വെർനിയർ കാലിപേർസ്

c. ന്യൂട്ടന്റെ വർണ്ണപമ്പരം

d. സെപറേറ്റിംഗ് ഫണൽ

54. താഴെ കൊടുത്തിരിക്കുന്ന സംയുക്തങ്ങളിൽ സോഡിയം അടങ്ങിയ സംയുക്തം ഏത്?

a. H_2O
b. NaCl
c. H_2SO_4
d. $CaCl_2$

55. ഒരു മൂലകത്തിന്റെ പ്രതീകം Cm ആണ്. ഒരു ശാസ്ത്ര പ്രതിഭയുടെ ഓർമ നിലനിർത്താനാണ് ആ മൂലകത്തിന്റെ പേര് നൽകിയത്. പ്രതിഭ ആര്?

a. ജോസഫ് പ്രീസ്റ്റില
b. മേരിക്യൂറി
c. ഹെന്റി കാവൻഡിഷ്
d. ഏണസ്റ്റ് റുഥർഫോർഡ്

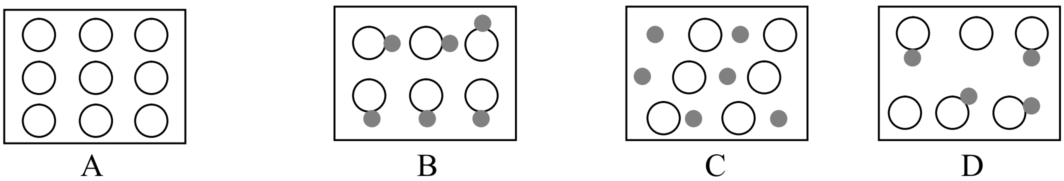
56. ഞാൻ ഒരു മൂലകമാണ്. ഞാൻ പഞ്ചസാരയിലുണ്ട്. കാർബൺ ഡൈ ഓക്സൈഡിൽ ഇല്ല. ജലത്തിലുണ്ട്. എന്റെ പ്രതീകം എന്ത്?

a. H
b. O
c. C
d. N

57. പഞ്ചസാരയിലെ ഘടകമൂലകങ്ങൾ ഏതെല്ലാം?

a. C, N, O
b. C, H, O
c. C, N, H
d. H, O, N

58.



മുകളിലെ ചിത്രങ്ങളിൽ ഏതിലാണ് മൂലകങ്ങൾ മാത്രമുള്ള മിശ്രിതം?

a. A
b. B
c. C
d. D

59. 5 Al എന്ന് എഴുതുമ്പോൾ അതിൽ '5' എന്നത് എന്തിനെയാണ് സൂചിപ്പിക്കുന്നത്?

a. ആറ്റങ്ങളുടെ എണ്ണം
b. സംയുക്തങ്ങളുടെ എണ്ണം
c. ആറ്റോമിക നമ്പർ
d. മാസ് നമ്പർ

60. ചില മൂലകങ്ങളുടെ പേരുകളും ചുരുക്കെഴുത്തും (പ്രതീകം) കൊടുത്തിട്ടുണ്ട്. ഉചിതമായ ബന്ധം ഏത്?

1.	അലുമിനിയം	a.	Hg
2.	സോഡിയം	b.	Au
3.	ഗോൾഡ്	c.	Na
4.	മെർക്കുറി	d.	Al

a. 1-c, 2-b, 3-d, 4-a
b. 1-d, 2-c, 3-b, 4-a
c. 1-b, 2-c, 3-a, 4-d
d. 1-a, 2-d, 3-c, 4-b

Appendix- D2

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY
(Draft)

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Instructions: This test is to measure the process skills in chemistry. For each question four options 'a', 'b', 'c', 'd' are given. After reading each question carefully, identify the correct answer and mark in the appropriate box in the answer sheet provided. Answer the questions in less than one minute. Don't write or draw anything on the question paper.

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1. Which of the following elements has greatest stability?
   a. Nitrogen
   b. Oxygen
   c. Flourine
   d. Neon
2. Which compound has greater number of atoms?
   a. H_2S
   b. NaCl
   c. 2 MgO
   d. 4 HCl
3. Find out correct match from the following

1. Proton	A. Bohr
2. Electron	B. J.J. Thomson
3. Neutron	C. Rutherford
4. Orbital	D. Chadwick

   a. 1-B, 2-C, 3-A, 4-D
   b. 1-C, 2-B, 3-D, 4-A
   c. 1-D, 2-A, 3-C, 4-B
   d. 1-A, 2-D, 3-B, 4-C
4. I am an element, for the first time Joseph Priestly prepared me by heating Mercuric Oxide and without me you can't exist. Guess who I am?
   a. H
   b. O
   c. N
   d. F

5. What is the basis of arrangements of elements in the modern periodic table
   a. Atomic number
   b. Atomic mass
   c. Metallic property
   d. Size of the elements
6. Find out the odd one?
   a. Period
   b. Group
   c. Symbols
   d. Orbits
7. Properties of the elements are similar along a group what is the reason for it?
   a. Chemical properties are same
   b. Physical properties are same
   c. Number of valence electrons are same
   d. Same atomic number
8. $2\ Na + Cl_2 \longrightarrow 2\ NaCl$

   $2\ Mg + O_2 \longrightarrow 2\ MgO$

   Analyse the reactions represented above and find out which of the following group contain only reactants?
   a. Na, Cl, Mg, O
   b. NaCl, Na, Mg, O
   c. MgO, Mg, Na, Cl
   d. NaCl, MgO, Cl, O
9. Which of the following is the chemical formula of Sulphuric acid?
   a. HCl
   b. HNO_3
   c. H_2SO_4
   d. H_3SO_4
10. From your daily observations which of the following is an example of chemical change?
    a. Burning of Magnesium
    b. Melting of Ice
    c. Evaporation of water
    d. Melting of wax

11. Below are some statements related to the different states of matters. From that pick out the wrong one?

    a. When a solid changes in to a liquid distance between the molecules increases

    b. When a gas changes in to a liquid the force of attraction between molecules increases.

    c. When a liquid changes in to a solid the distance between the molecules increases.

    d. Volume of a gas is equal to the volume of the container occupied by the gas.

12. What is the reason for increase in heat during summer season while wearing black dresses?

    a. Black colour reflects all other colours.

    b. Black colour absorbs all other colours.

    c. Black color produces more heat.

    d. Black colour has least capacity to absorb heat

13. From the following, find out the odd one

    a. Lavosia

    b. Dobiriner

    c. Medeleive

    d. Dalton

14. The window rods of the houses on the sea shore are corroted quickly than that of other areas. Why does it happen?

    a. Humidity is higher on Sea land

    b. Humidity is lower on Sea land

    c. Quality of Iron is poor

    d. Amount of impurities is higher

15. If you observe a atom model with a galaxy which place in atom is equivalent to sun?

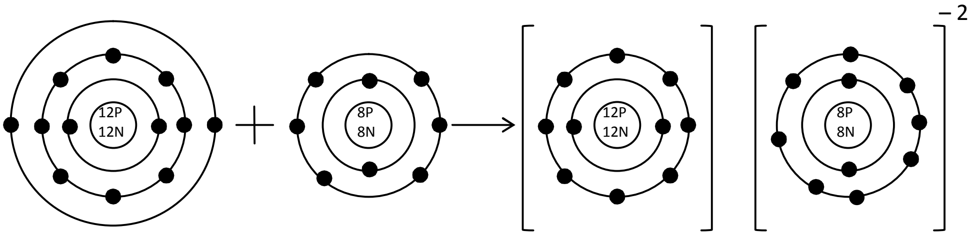
    a. Shell

    b. Electron

    c. Nucleus

    d. Proton

16. Picture show the Bohr model of the reaction between Magnesium and Oxygen produces Magnesium Oxide. Write answer for the question below



What is the charge of Magnesium?

a. +2
b. -2
c. +1
d. -1

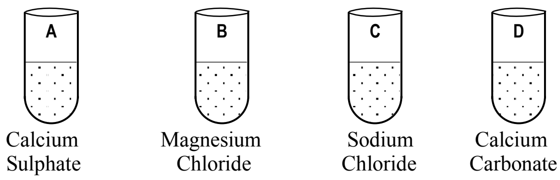
17. From the following find out metal in the liquid state?

a. Mercury
b. Zinc
c. Sulphur
d. Aluminum

18. The filaments of Bulbs are made by which metal?

a. Silver
b. Osmium
c. Copper
d. Tungsten

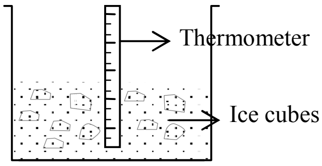
Four test tubes are given with solutions of different substances. By observing these test tubes find out answer for the following two questions?



19. In which solution hardness can be removed by boiling?

a. A
b. B
c. C
d. D

Picture shows some ice cubes are taken a beaker and put a thermo meter in it.



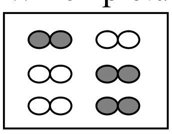
20. In the above picture what changes occur to the ice?
    a. Melts
    b. Doesn't melt
    c. Mets on heating
    d. None of these
21. Leena teacher provided you sugar in one beaker and water in other and asked to prepare sugar solution. Identify the solute in sugar solution?
    a. Sugar
    b. Water
    c. Insoluble
    d. Soluble on heating

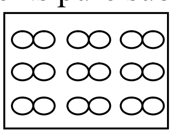
$\boxed{{}_{14}Si^{28}}$

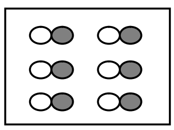
Box indicates periodic table representation of the element silicon. From this write down the following characteristics of the element.

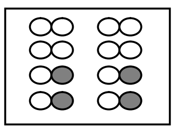
22. What is the symbol?
    a. Ti
    b. V
    c. Si
    d. S
23. What is the atomic number?
    a. 7
    b. 14
    c. 12
    d. 28
24. What is the mass number?
    a. 7
    b. 12
    c. 14
    d. 28

25. The electronic configuration of potassium is 2, 8, 8, 1 for calcium it is 2, 8, 8, 2. From this identity the element with lowest number of atoms?
    a. Ca
    b. Mg
    c. Na
    d. K
26. Atomic number of sodium is 11 and Mass number is 23. find out the number of neutrons in sodium?
    a. 13
    b. 11
    c. 12
    d. 23
27. Electronic configurations of some elements are given. From this, which element has biggest atomic size?
    a. 2
    b. 2, 8
    c. 2, 8, 2
    d. 2, 8, 8, 2
28. Identify the element which gives hydrogen when react with acid.
    a. Sodium
    b. Chlorine
    c. Barium
    d. Chromium
29. Did you notice why salts are scattered on the road in cold countries?
    a. Salt increases the rate of melting of ice
    b. Salt increases the surface tension of ice
    c. Salt is denser than ice
    d. Concentration of ice is more than salt
30. The p^H of vinegar is 5 and the p^H rain water is 6. From the statements given below, which explanation is more appropriate?
    a. Both are bases, though vinegar is more basic
    b. Both are acids, though vinegar is more acidic
    c. Both are bases, though rainwater is more basic
    d. Both are acids, though rainwater is more acidic
31. Which picture represents pure substance?


A


B


C


D

a. Picture A
b. Picture B
c. Picture C
d. Picture D

32. Atomic number of oxygen is ‘8’. Which is the representation of electronic configuration?
a. 2, 5
b. 2, 6
c. 2, 5, 1
d. 2, 4, 1

33. The electronic configuration of element is $1s^2 2s^2 2p^6 3s^2$. What is its atomic number?

a.	14	c.	10
b.	12	d.	13

34. Some mixtures and their separating methods are given. Find out the correct match.

1.	Cream from milk	a.	Separating funnel
2.	Black ink from sketch pen	b.	Centrifuge
3.	Water and kerosene	c.	Chromatography
4.	Mixture of mud and water	d.	Filter paper

a. 1-c, 2-a, 3-b, 4-d
b. 1-b, 2-c, 3-a, 4-d
c. 1-a, 2-c, 3-a, 4-a
d. 1-d, 2-b, 3-d, 4-c

35. If a glass rod is immersed in water, water get adhered on the rod. Whereas glass rod immersed in mercury doesn’t adhered. Why?
a. Adhesive force
b. Cohesive force
c. Surface tension
d. Low viscosity

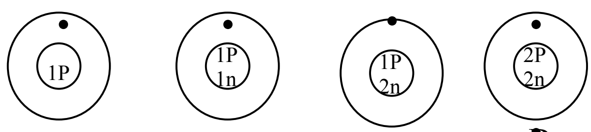
36. Science teacher gave Neethu two salts in the laboratory. Neethu added con HCl in to each and made it a paste. When exposed small amount of paste the flame, one shows colour of brick red and other shows pale green colour. What are the salts?
a. Ca, Ba
b. Sr, Br
c. Na, Ca
d. K, Na

37. Element 'X' (Electronic configuration 2, 8, 1) and element 'Y' (Electronic configuration 2, 8, 7) combines to form 'XY'. What is the nature of bond in the compound 'XY'.
    a. Metallic bond
    b. Ionic bond
    c. Compound bond
    d. Covalent bond
38. Reaction between hydrogen and nitrogen produces ammonia. How will you write this in language of chemistry?
    a. $N + 3H \rightarrow NH_3$
    b. $N+3H_3 \rightarrow NH_3$
    c. $2N_2 + 2H_2 \rightarrow 2NH_3$
    d. $N_2 + 3H_2 \rightarrow 2NH_3$
39. If the P^H of a solution is 4.8 the property of the solution will be
    a. Acidic
    b. Alkaline
    c. Neutral
    d. Aqeous
40. Number of maximum electrons occupy in the fourth shell of an atom is
    a. 31
    b. 32
    c. 33
    d. 35

Atom of the element 'A' has three shells and its third shell contain four electrons.

41. What is the atomic number of 'A'?
    a. 14
    b. 13
    c. 15
    d. 16
42. Number of electrons in the atom is
    a. 14
    b. 13
    c. 15
    d. 16

Different forms of hydrogen in nature is picturised below



A B C D

43. What is the name of 'A'?
    a. Protium
    b. Deuterium
    c. Tritium
    d. None of these
44. By examining the short hand representation of elements find out the isobar among them?

I	II	III	IV	V
$^{40}_{18}A$	$^{35}_{17}B$	$^{40}_{20}C$	$^{36}_{17}D$	$^{23}_{11}E$

    a. I & II
    b. I & III
    c. II & III
    d. I & V

The compound CH_4 contain

45. Number of carbon atoms
    a. 2
    b. 1
    c. 4
    d. 5
46. No. of hydrogen atoms
    a. 4
    b. 5
    c. 1
    d. 2
47. Total number of atoms
    a. 5
    b. 6
    c. 1
    d. 4
48. Identify the multi atomic molecule from the following elements?
    a. S_8
    b. Na
    c. P_4
    d. O_2
49. Electronic configuration of some elements are given below.

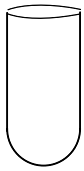
Element A - 2, 8, 8　　Element C - 2, 8

Element B - 2, 8, 1　　Element D - 2

Among theme which element has more tendency to engage in chemical reaction

a. Element A
b. Element B
c. Element C
d. Element D

50. What is the name of equipment shown below



a. Test tube
b. Beaker
c. Tisil Funnel
d. Glass rod

51. Whether the surface tension cause shrinking or expansion of surface of liquids.

a. Shrink
b. Expand
c. Constant state
d. None of these

52. Find out the appropriate method for separating each elements from the mixtures

1. Acetone and Water	:	A: fractional distillation
2. Salt water	:	B: Distillation
3. Mixture of mud & Water	:	C: Evaporation
4. Mixture of ethanol & methanol	:	D: Filtration

a. 1-c, 2-a, 3-b, 4-d
b. 1-c, 2-b, 3-d, 4-a
c. 1-a, 2-c, 3-a, 4-a
d. 1-d, 2-b, 3-d, 4-c

53. Identify equipment shown below?

a. Centrifuge
b. Vernier caliperse
c. Newton's colour disc
d. Separating funnel

54. Find out the compound which contain sodium?

a. H_2O
b. NaCl
c. H_2SO_4
d. $CaCl_2$

55. Symbol of an element is 'cm'. This name was given for the memory of a scientist. Who is that scientist?

a. Joseph priestly
b. Mary curie
c. Henry Cavendish
d. Earnest Rutherford

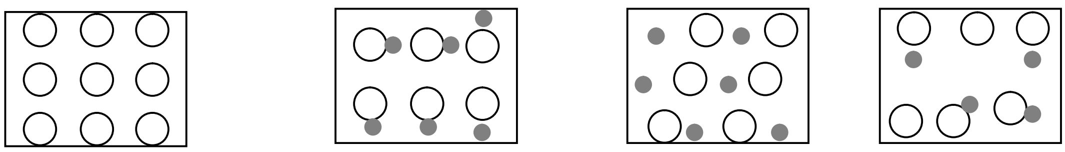
56. I am a element, present in sugar and absent in carbon dioxide. What is my symbol?

a. H
b. O
c. C
d. N

57. What are the individual elements in sugar?

a. C, N, O
b. C, H, O
c. C, N, H
d. H, O, N

58.



A B C D

Which of the above picture represents mixture which contain only elements

a. A
b. B
c. C
d. D

59. What is mean by 5 in 5Al?

a. Number atoms
b. Number of compounds
c. Atomic number
d. Mass number

60. Some elements and their symbols are given. Which is the correct match?

1.	Aluminium	a.	Hg
2.	Sodium	b.	Au
3.	Gold	c.	Na
4.	Mercury	d.	Al

a. 1-c, 2-b, 3-d, 4-a
b. 1-d, 2-c, 3-b, 4-a
c. 1-b, 2-c, 3-a, 4-d
d. 1-a, 2-d, 3-c, 4-b

Appendix- D3

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY
(Draft)

Scoring Key

Ques. No.	Answer
1	d
2	d
3	b
4	b
5	a
6	d
7	c
8	a
9	c
10	a
11	c
12	b
13	d
14	a
15	c
16	a
17	a
18	d
19	d
20	a

Ques. No.	Answer
21	a
22	c
23	b
24	d
25	d
26	c
27	d
28	a
29	a
30	b
31	b
32	b
33	b
34	a
35	d
36	a
37	b
38	d
39	a
40	b

Ques. No.	Answer
41	a
42	a
43	a
44	b
45	b
46	a
47	a
48	a
49	b
50	a
51	a
52	b
53	a
54	b
55	b
56	c
57	b
58	a
59	a
60	b

Appendix- D4

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY

(Final)

Dr. A. Hameed — **Meharunnisa Karadan**
Assistant Professor — Research Scholar

നിർദ്ദേശങ്ങൾ:

രസതന്ത്രത്തിലെ പ്രക്രിയാനൈപുണികൾ അളക്കുന്നതിനുള്ള ഒരു പരീക്ഷയാണിത്. ഓരോ ചോദ്യത്തിനും നേരെ a, b, c, d എന്നിങ്ങനെ അക്ഷരങ്ങളിട്ട് നാല് ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ നിന്നും ശരിയുത്തരം കണ്ടുപിടിച്ച് ഉത്തരക്കടലാസിൽ ചോദ്യത്തിനു നേരെ കൊടുത്തിട്ടുള്ള ബോക്സിൽ രേഖപ്പെടുത്തുക. പരമാവധി ചുരുങ്ങിയ സമയത്തിനുള്ളിൽ ചോദ്യങ്ങൾക്ക് ഉത്തരം രേഖപ്പെടുത്തണം. ചോദ്യപേപ്പറിൽ ഒന്നും എഴുതുകയോ വരയ്ക്കുകയോ ചെയ്യരുത്

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1. താഴെ കൊടുത്തിരിക്കുന്ന മൂലകങ്ങളിൽ ഏറ്റവും കൂടുതൽ സ്ഥിരത ഏതിനാണ്?
   a. നൈട്രജൻ
   b. ഓക്സിജൻ
   c. ഫ്ളൂറിൻ
   d. നിയോൺ
2. ഏറ്റവും കൂടുതൽ ആറ്റം ഉള്ള സംയുക്തം ഏത്?
   a. H_2S
   b. NaCl
   c. 2 MgO
   d. 4 HCl
3. ഞാൻ ഒരു മൂലകമാണ്. ജോസഫ് പ്രീസ്റ്റിലിയാണ് എന്നെ ആദ്യമായി നിർമ്മിച്ചത്. മെർക്കുറിക് ഓക്സൈഡ് ചൂടാക്കുമ്പോൾ ഞാനുണ്ടാകുന്നുണ്ട്. എന്താണ് എന്റെ പ്രതീകം?
   a. H
   b. O
   c. N
   d. F
4. ഒരേ ഗ്രൂപ്പിൽ വരുന്ന മൂലകങ്ങൾ സമാന ഗുണങ്ങൾ ആവർത്തിക്കാനുള്ള കാരണം എന്തായിരിക്കും?
   a. രാസഗുണങ്ങൾ സമാനമായതിനാൽ
   b. ഭൗതികഗുണങ്ങൾ സമാനമായതിനാൽ
   c. വാലൻസ് ഇലക്ട്രോണുകളുടെ എണ്ണം സമാനമായതിനാൽ
   d. ആറ്റോമിക നമ്പർ സമാനമായതിനാൽ

5. $2\ Na + Cl_2 \rightarrow 2\ NaCl$

   $2\ Mg + O_2 \rightarrow 2\ MgO$

   മുകളിലെ രാസ പ്രവർത്തനങ്ങളിൽ അഭികാരകങ്ങളെ കാണിക്കുന്ന ശരിയായ ഗ്രൂപ്പ് ഏത്?

   a. Na, Cl, Mg, O
   b. NaCl, Na, Mg, O
   c. MgO, Mg, Na, Cl
   d. NaCl, MgO, Cl, O

6. നിങ്ങൾ ചുറ്റുപാടുകൾ നിരീക്ഷിച്ചതിൽ നിന്നും താഴെ കൊടുത്തരിക്കുന്നവയിൽ രാസമാറ്റം ഏത്?

   a. മെഗ്നീഷ്യം കത്തുന്നു
   b. മെഴുക് ഉരുകുന്നു
   c. ജലം നീരാവിയാകുന്നു
   d. ഐസ് ഉരുകുന്നു

7. ദ്രവ്യത്തിന്റെ വിവിധ അവസ്ഥകളുമായി ബന്ധപ്പെട്ട പ്രസ്താവനകൾ കൊടുത്തിരിക്കുന്നു. ഇവയിൽ ഏതാണ് തെറ്റ്?

   a. ഖരം ദ്രാവകമാകുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള അകലം കൂടുന്നു.
   b. വാതകം ദ്രാവകമായി മാറുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള ആകർഷണബലം കൂടുന്നു.
   c. ദ്രാവകം ഖരമായി മാറുമ്പോൾ തന്മാത്രകൾ തമ്മിലുള്ള അകലം കൂടുന്നു.
   d. വാതകങ്ങളുടെ വ്യാപ്തം, അതു സ്ഥിതി ചെയ്യുന്ന പാത്രത്തിന്റെ വ്യാപ്തത്തിന് തുല്യമാകും.

8. താഴെ കൊടുത്തിരിക്കുന്ന ഗ്രൂപ്പുകളിൽ നിന്നും കൂട്ടത്തിൽ ചേരാത്തതിനെ കണ്ടെത്തുക.

   a. ലാവോസിയ
   b. ഡൊബൈറൈനർ
   c. മെൻഡലിയേഫ്
   d. ഡാൽട്ടൻ

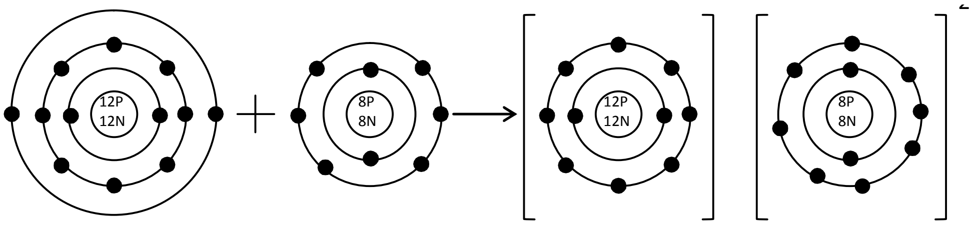
9. കടൽ പ്രദേശങ്ങളിലുള്ള വീടുകളിലെ ജനൽ കമ്പികൾ മറ്റ് പ്രദേശങ്ങളിലേക്കാൾ പെട്ടെന്ന് തുരുമ്പിക്കുന്നതായി കാണപ്പെടുന്നു. ഇതിന്റെ കാരണം എന്താവാം?

   a. കടൽ പ്രദേശങ്ങളിൽ ആർദ്രത കൂടുതലായത്കൊണ്ട്
   b. കടൽ പ്രദേശങ്ങളിൽ ആർദ്രത കുറവായത്കൊണ്ട്
   c. ഇരുമ്പിന്റെ ഗുണനിലവാരം കുറവായത്കൊണ്ട്
   d. അശുദ്ധപദാർത്ഥങ്ങൾ കുടുതലായത്കൊണ്ട്.

10. ആറ്റം മാതൃകയെ സൗരയൂഥവുമായി താരതമ്യം ചെയ്ത് നിരീക്ഷിച്ചാൽ സൂര്യന് സമാനമായ ആറ്റത്തിലെ ഭാഗം ഏത്?

   a. ഷെൽ
   b. ഇലക്ട്രോൺ
   c. ന്യൂക്ലിയസ്
   d. പ്രോട്ടോൺ

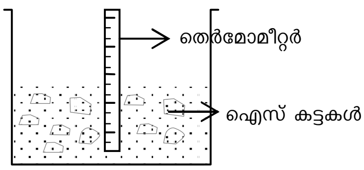
11. മഗ്നീഷ്യം ഓക്സിജനുമായി ചേർന്ന് മഗ്നീഷ്യം ഓക്സൈഡ് ഉണ്ടാകുന്നതിന്റെ ബോർ മാതൃകയാണ് കാണിച്ചിരിക്കുന്നത്. ഇത് നിരീക്ഷിച്ച് താഴെ തന്നിരിക്കുന്ന ചോദ്യത്തിന് ഉത്തരം നൽകുക.



മുകളിലെ ചിത്രത്തിൽ മഗ്നീഷ്യത്തിന്റെ ചാർജ് എത്ര?

a. +2
b. −2
c. +1
d. −1

<u>ഒരു ബീക്കറിൽ ഐസ് കട്ടകളെടുത്ത് അതിൽ ഒരു തെർമോമീറ്റർ സാധാരണ ഊഷ്മാവിൽ വച്ചിരിക്കുന്ന ചിത്രം കാണിച്ചിരിക്കുന്നു.</u>



12. മുകളിലെ ചിത്രത്തിൽ ഐസിനുണ്ടാകുന്ന അവസ്ഥാമാറ്റം എന്ത്?

a. ഉരുകുന്നു
b. ഉരുകുന്നില്ല
c. ചൂടാക്കുമ്പോൾ ഉരുകുന്നു
d. ഇതൊന്നുമല്ല

13. ലബോറട്ടറിയിൽ ലീനടീച്ചർ നിങ്ങൾക്ക് കുറച്ച് പഞ്ചസാരയും ഒരു ബീക്കറിൽ ജലവും തന്നു. എന്നിട്ട് നിങ്ങളോട് പഞ്ചസാരവെള്ളം നിർമ്മിക്കുവാൻ ആവശ്യപ്പെടുന്നു. ഈ പദാർത്ഥത്തിലെ ലീനം ഏത്?

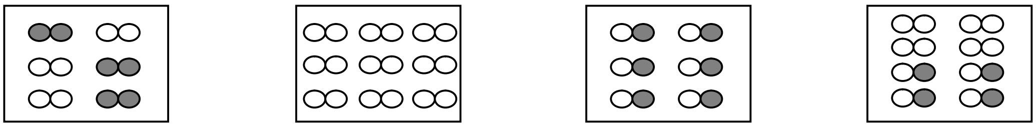
a. പഞ്ചസാര
b. വെള്ളം
c. ലയിക്കുന്നില്ല
d. ചൂടാക്കുമ്പോൾ മാത്രം ലയിക്കുന്നു

$\boxed{_{14}Si^{28}}$

സിലിക്കൺ എന്ന മൂലകത്തിന്റെ പിരിയോഡിക് ടേബിളിലെ ചിത്രീകരണം ആണ് കാണിച്ചിരിക്കുന്നത്. ഇതിൽ നിന്നും ആ മൂലകത്തിന്റെ താഴെ പറയുന്ന പ്രത്യേകതകൾ എഴുതുക.

14. പ്രതീകം എന്ത്?
    a. Ti
    b. V
    c. Si
    d. S
15. ആറ്റോമിക നമ്പർ എത്ര?
    a. 7
    b. 14
    c. 12
    d. 28
16. മാസ് നമ്പർ എത്ര?
    a. 7
    b. 12
    c. 14
    d. 28
17. പൊട്ടാസ്യത്തിന്റെ ഇലക്ട്രോൺ ക്രമീകരണം 2, 8, 8, 1ഉം, കാൽസ്യത്തിന്റെ ഇലക്ട്രോൺ ക്രമീകരികരണം 2, 8, 8, 2 എന്നും ആണ്. ഏതിലാണ് കുറഞ്ഞ എണ്ണം ആറ്റം ഉള്ളത്?
    a. Ca
    b. Mg
    c. Na
    d. K
18. സോഡിയത്തിന്റെ ആറ്റോമിക നമ്പർ 11 ഉം മാസ് നമ്പർ 23 ഉം ആണെങ്കിൽ സോഡിയത്തിൽ അടങ്ങിയിട്ടുള്ള ന്യൂട്രോണുകളുടെ എണ്ണം കണ്ടുപിടിക്കുക.
    a. 13
    b. 11
    c. 12
    d. 23
19. ചില മൂലകങ്ങളുടെ ഇലക്ട്രോൺ വിന്യാസം തന്നിരിക്കുന്നു. ഇവയിൽ ഏറ്റവും വലിയ ആറ്റമുള്ള മൂലകം ഏത്?
    a. 2
    b. 2, 8
    c. 2, 8, 2
    d. 2, 8, 8, 2
20. വിനാഗിരിയുടെ pH 5ഉം മഴവെള്ളത്തിന്റെ pH 6ഉം ആണെന്ന് തന്നിരിക്കുന്നു. താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ ഇതിന് ഏറ്റവും അനുയോജ്യമായ വിശദീകരണം ഏത്?
    a. രണ്ടും ബേസുകളാണ്, വിനാഗിരിയാണ് കൂടുതൽ ബേസിക്
    b. രണ്ടും ആസിഡുകളാണ്, വിനാഗിരിയാണ് കൂടുതൽ അസിഡിക്
    c. രണ്ടും ബേസുകളാണ്, മഴവെള്ളമാണ് കൂടുതൽ ബേസിക്
    d. രണ്ടും ആസിഡുകളാണ്, മഴവെള്ളമാണ് കൂടുതൽ അസിഡിക്

21. താഴെ കൊടുത്തിരിക്കുന്ന ചിത്രങ്ങളിൽ ശുദ്ധപദാർത്ഥത്തെ സൂചിപ്പിക്കുന്ന ചിത്രം ഏത്?



A B C D

a. ചിത്രം A
b. ചിത്രം B
c. ചിത്രം C
d. ചിത്രം D

22. നീതുവിന് സയൻസ് ലാബിൽ നിന്ന് രണ്ട് ലവണങ്ങൾ ടീച്ചർ നൽകി. ഓരോന്നിലും ഗാഢ HCl ചേർത്ത കുഴമ്പ് രൂപത്തിലാക്കി, അല്പം എടുത്ത് ത്വീജ്വാലയിൽ കാണിച്ച പ്പോൾ ഒന്ന് ചുടുകട്ടയുടെ നിറവും മറ്റൊന്ന് ഇളം പച്ച നിറവും കാണിച്ചു. ലവണങ്ങൾ ഏവ?

a. Ca, Ba
b. Sr, Br
c. Na, Ca
d. K, Na

23. 'X'എന്ന മൂലകം(ഇലക്ട്രോൺ ക്രമീകരണം 2,8,1), 'Y' എന്ന മൂലകം (ഇലക്ട്രോൺ ക്രമീകരണം 2,8,7) സംയോജിച്ച് 'XY' എന്ന സംയുക്തം ഉണ്ടാകുന്നു. ഈ സംയുക്ത ത്തിൽ ഉണ്ടാകുന്നത് ഏത് തരം രാസബന്ധനം ആണ്?

a. ലോഹീയ ബന്ധനം
b. അയോണിക ബന്ധനം
c. സംയുക്ത ബന്ധനം
d. സഹസംയോജക ബന്ധനം

24. ഒരു ലായനിയുടെ pH മൂല്യം 4 ആണ്. താഴെ പറയുന്നതിൽ ഏത് സ്വഭാവമായി രിക്കും ലായനി കാണിക്കുക?

a. അസിഡിക്
b. ആൽക്കലൈൻ
c. ന്യൂട്രൽ
d. ജലം

25. ഒരു ആറ്റത്തിന്റെ നാലാമത്തെ ഷെല്ലിൽ ഉൾക്കൊള്ളാവുന്ന പരമാവധി ഇലക് ട്രോണുകളുടെ എണ്ണം എത്ര?

a. 31
b. 32
c. 33
d. 35

26. 'A' എന്ന മൂലകത്തിന്റെ ആറ്റത്തിന് മൂന്ന് ഷെല്ലുകൾ ഉണ്ട്. അതിന്റെ മൂന്നാമത്തെ ഷെല്ലിൽ 4 ഇലക്ട്രോണുകൾ ഉണ്ട് എങ്കിൽ ഇലക്ട്രോണുകളുടെ എണ്ണം എത്ര?

a. 14
b. 13
c. 15
d. 16

27. CH_4 തന്മാത്രയിൽ അടങ്ങയിരിക്കുന്ന കാർബൺ ആറ്റങ്ങളുടെ എണ്ണം എത്ര?

a. 2
b. 1
c. 4
d. 5

28. താഴെ കൊടുത്തിരിക്കുന്നതിൽ ബഹു ആറ്റോമിക തന്മാത്ര ഏതാണെന്ന് കാണ്ടെത്തുക?

a. S_8
b. Na
c. P_4
d. O_2

29. ചില മൂലകങ്ങളുടെ ഇലക്ട്രോൺ വിന്യാസം താഴെ നൽകിയിരിക്കുന്നു.

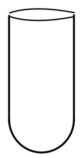
മൂലകം A- 2, 8, 8   മൂലകം C- 2, 8

മൂലകം B- 2, 8, 1   മൂലകം D- 2

ഇവയിൽ രാസപ്രവർത്തനത്തിൽ ഏർപ്പെടാൻ സാധ്യതയുള്ള മൂലകം ഏതായിരിക്കും?

a. മൂലകം A
b. മൂലകം B
c. മൂലകം C
d. മൂലകം D

30. ചിത്രത്തിൽ കാണിച്ചിരിക്കുന്ന ഉപകരണത്തിന് പറയുന്ന പേരെന്ത്?



a. ടെസ്റ്റ്യൂബ്
b. ബീക്കർ
c. തിസിൽ ഫണൽ
d. ഗ്ലാസ്റോഡ്

31. പ്രതലബലം ദ്രാവകങ്ങളുടെ പ്രതലങ്ങളെ ചുരുങ്ങുന്നതിനാണോ വികസിക്കുന്നതിനാണോ പ്രേരിപ്പിക്കുന്നത്?

a. ചുരുങ്ങുവാൻ
b. വികസിക്കുവാൻ
c. സ്ഥിരാവസ്ഥയിൽ തുടരുവാൻ
d. ഇതൊന്നുമല്ല

32. താഴെ കൊടുത്തിരിക്കുന്ന സംയുക്തങ്ങളിൽ സോഡിയം അടങ്ങിയ സംയുക്തം ഏത്?

a. H_2O
b. NaCl
c. H_2SO_4
d. $CaCl_2$

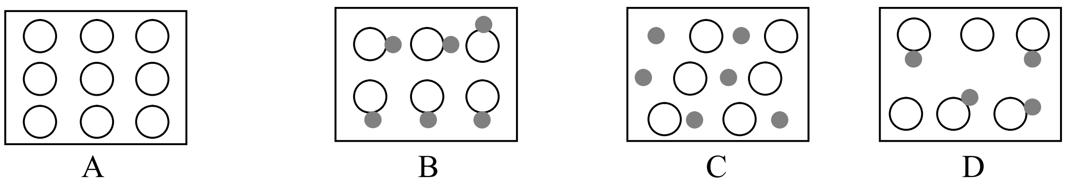
33. ഞാൻ ഒരു മൂലകമാണ്. ഞാൻ പഞ്ചസാരയിലുണ്ട്. കാർബൺ ഡൈ ഓക്സൈഡിൽ ഇല്ല. ജലത്തിലുണ്ട്. എന്റെ പ്രതീകം എന്ത്?

a. H
b. O
c. C
d. N

34. പഞ്ചസാരയിലെ ഘടകമൂലകങ്ങൾ ഏതെല്ലാം?

a. C, N, O
b. C, H, O
c. C, N, H
d. H, O, N

35.



മുകളിലെ ചിത്രങ്ങളിൽ ഏതിലാണ് മൂലകങ്ങൾ മാത്രമുള്ള മിശ്രിതം?

a. A
b. B
c. C
d. D

36. ചില മൂലകങ്ങളുടെ പേരുകളും ചുരുക്കെഴുത്തും (പ്രതീകം) കൊടുത്തിട്ടുണ്ട്. ഉചിതമായ ബന്ധം ഏത്?

1.	അലുമിനിയം	a.	Hg
2.	സോഡിയം	b.	Au
3.	ഗോൾഡ്	c.	Na
4.	മെർക്കുറി	d.	Al

a. 1-c, 2-b, 3-d, 4-a
b. 1-d, 2-c, 3-b, 4-a
c. 1-b, 2-c, 3-a, 4-d
d. 1-a, 2-d, 3-c, 4-b

Appendix- D5

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY
(Final)

Dr. A. Hameed — Assistant Professor

Meharunnisa Karadan — Research Scholar

Instructions: This test is to measure the process skills in chemistry. For each question four options 'a', 'b', 'c', 'd' are given. After reading each question carefully, identify the correct answer and mark in the appropriate box in the answer sheet provided. Answer the questions in less than one minute. Don't write or draw anything on the question paper.

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1. Which of the following elements has greatest stability?
   a. Nitrogen
   b. Oxygen
   c. Flourine
   d. Neon
2. Which compound has greater number of atoms?
   a. H_2S
   b. NaCl
   c. 2 MgO
   d. 4 HCl
3. I am an element, for the first time Joseph Priestly prepared me by heating Mercuric Oxide and without me you can't exist. Guess who I am?
   a. H
   b. O
   c. N
   d. F
4. Properties of the elements are similar along a group what is the reason for it?
   a. Chemical properties are same
   b. Physical properties are same
   c. Number of valence electrons are same
   d. Same atomic number

5. $2\,Na + Cl_2 \rightarrow 2\,NaCl$

   $2\,Mg + O_2 \rightarrow 2\,MgO$

   Analyse the reactions represented above and find out which of the following group contain only reactants?

   a. Na, Cl, Mg, O
   b. NaCl, Na, Mg, O
   c. MgO, Mg, Na, Cl
   d. NaCl, MgO, Cl, O

6. From your daily observations which of the following is an example of chemical change?

   a. Burning of Magnesium
   b. Melting of Ice
   c. Evaporation of water
   d. Melting of wax

7. Below are some statements related to the different states of matters. From that pick out the wrong one?

   a. When a solid changes in to a liquid distance between the molecules increases
   b. When a gas changes in to a liquid the force of attraction between molecules increases.
   c. When a liquid changes in to a solid the distance between the molecules increases.
   d. Volume of a gas is equal to the volume of the container occupied by the gas.

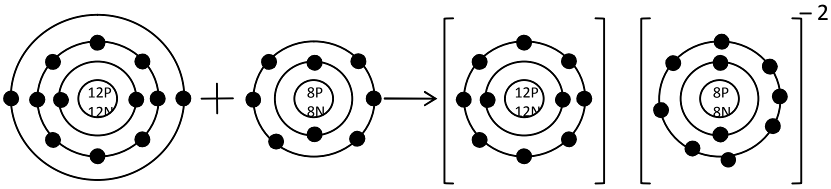
8. From the following find out the odd one

   a. Lavosia
   b. Dobiriner
   c. Medeleive
   d. Dalton

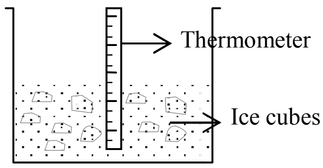
9. The window rods of the houses on the sea shore are corroted quickly than that of other areas. Why does it happen?

   a. Humidity is higher on Sea land
   b. Humidity is lower on Sea land
   c. Quality of Iron is poor
   d. Amount of impurities is higher

10. If you observe a atom model with a galaxy which place in atom is equivalent to sun?
    a. Shell
    b. Electron
    c. Nucleus
    d. Proton
11. Picture show the Bohr model of the reaction between Magnesium and Oxygen produces Magnesium Oxide. Write answer for the question below



What is the charge of Magnesium?
    a. +2
    b. -2
    c. +1
    d. -1
12. Picture shows some ice cubes are taken a beaker and put a thermo meter in it. In the above picture what changes occur to the ice?



    a. Melts
    b. Doesn't melt
    c. Mets on heating
    d. None of these
13. Leena teacher provided you sugar in one beaker and water in other and asked to prepare sugar solution. Identify the solute in sugar solution?
    a. Sugar
    b. Water
    c. Insoluble
    d. Soluble on heating

$\boxed{{}_{14}Si^{28}}$

Box indicates periodic table representation of the element silicon. From this write down the following characteristics of the element.

14. What is the symbol?

    a. Ti
    b. V
    c. Si
    d. S

15. What is the atomic number?

    a. 7
    b. 14
    c. 12
    d. 28

16. What is the mass number?

    a. 7
    b. 12
    c. 14
    d. 28

17. The electronic configuration of potassium is 2, 8, 8, 1 for calcium it is 2, 8, 8, 2. From this identity the element with lowest number of atoms?

    a. Ca
    b. Mg
    c. Na
    d. K

18. Atomic number of sodium is 11 and Mass number is 23. find out the number of neutrons in sodium?

    a. 13
    b. 11
    c. 12
    d. 23

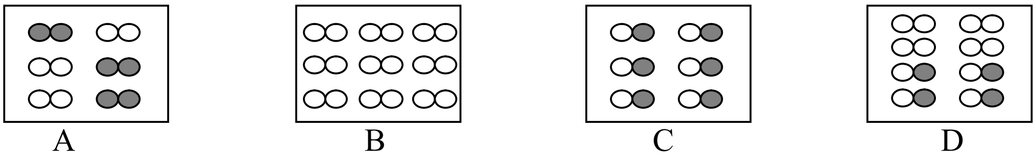
19. Electronic configurations of some elements are given. From this, which element has biggest atomic size?

    a. 2
    b. 2, 8
    c. 2, 8, 2
    d. 2, 8, 8, 2

20. The p^H of vinegar is 5 and the p^H rain water is 6. From the statements given below, which explanation is more appropriate?

    a. Both are bases, though vinegar is more basic
    b. Both are acids, though vinegar is more acidic
    c. Both are bases, though rainwater is more basic
    d. Both are acids, though rainwater is more acidic

21. Which picture represents pure substance?



a. Picture A
b. Picture B
c. Picture C
d. Picture D

22. Science teacher gave Neethu two salts in the laboratory. Neethu added con HCl in to each and made it a paste. When exposed small amount of paste the flame, one shows colour of brick red and other shows pale green colour. What are the salts?

a. Ca, Ba
b. Sr, Br
c. Na, Ca
d. K, Na

23. Element ‘X’ (Electronic configuration 2, 8, 1) and element ‘Y’ (Electronic configuration 2, 8, 7) combines to form ‘XY’. What is the nature of bond in the compound ‘XY’.

a. Metallic bond
b. Ionic bond
c. Compound bond
d. Covalent bond

24. If the P^H of a solution is 4.8 the property of the solution will be

a. Acidic
b. Alkaline
c. Neutral
d. Aqeous

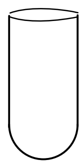
25. Number of maximum electrons occupy in the fourth shell of an atom is

a. 31
b. 32
c. 33
d. 35

26. Atom of the element ‘A’ has three shells and its third shell contain four electrons. Number of electrons in the atom is

a. 14
b. 13
c. 15
d. 16

27. The number of carbon atoms in compound CH_4 is
    a. 2
    b. 1
    c. 4
    d. 5
28. Identify the multi atomic molecule from the following elements?
    a. S_8
    b. Na
    c. P_4
    d. O_2
29. Electronic configuration of some elements are given below.
    Element A - 2, 8, 8   Element C - 2, 8
    Element B - 2, 8, 1   Element D - 2
    Among theme which element has more tendency to engage in chemical reaction
    a. Element A
    b. Element B
    c. Element C
    d. Element D
30. What is the name of equipment shown below



    a. Test tube
    b. Beaker
    c. Tisil Funnel
    d. Glass rod
31. Whether the surface tension cause shrinking or expansion of surface of liquids.
    a. Shrink
    b. Expand
    c. Constant state
    d. None of these
32. Find out the compound which contain sodium?
    a. H_2O
    b. NaCl
    c. H_2SO_4
    d. $CaCl_2$

33. I am a element, present in sugar and absent in carbon dioxide. What is my symbol?

a. H

b. O

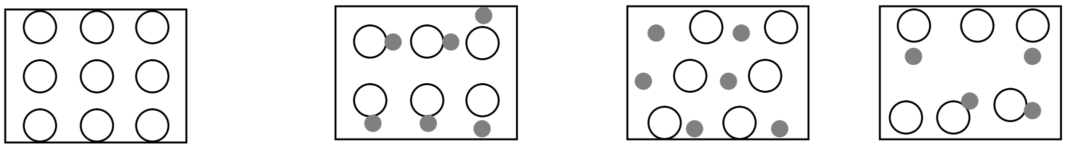
c. C

d. N

34. What are the individual elements in sugar?

a. C, N, O
b. C, H, O
c. C, N, H
d. H, O, N

35.



A B C D

Which of the above picture represents mixture which contain only elements

a. A

b. B

c. C

d. D

36. Some elements and their symbols are given. Which is the correct match?

1.	Aluminium	a.	Hg
2.	Sodium	b.	Au
3.	Gold	c.	Na
4.	Mercury	d.	Al

a. 1-c, 2-b, 3-d, 4-a

b. 1-d, 2-c, 3-b, 4-a

c. 1-b, 2-c, 3-a, 4-d

d. 1-a, 2-d, 3-c, 4-b

Appendix- D6

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY

Response Sheet

വിദ്യാർത്ഥിയുടെ പേര്:..

വിദ്യാലയത്തിന്റെ പേര്:... ക്ലാസ്:............

ആൺ/പെൺ:... ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

Sl. No	a	b	c	d
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				

Sl. No	a	b	c	d
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				
31.				
32.				
33.				
34.				
35.				
36.				
37				

Appendix- D7

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF BASIC PROCESS SKILLS IN CHEMISTRY
(Final)

Scoring Key

Ques. No.	Answer
1	d
2	d
3	b
4	c
5	a
6	a
7	c
8	d
9	a
10	c
11	a
12	a
13	a
14	c
15	b
16	d
17	d
18	c

Ques. No.	Answer
19	d
20	b
21	b
22	a
23	b
24	a
25	b
26	a
27	b
28	a
29	b
30	a
31	a
32	b
33	c
34	b
35	a
36	b

Appendix- E1

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED
PROCESS SKILLS IN CHEMISTRY
(Draft)

Dr. A. Hameed | **Meharunnisa Karadan**
Assistant Professor | Research Scholar

നിർദ്ദേശങ്ങൾ:

രസതന്ത്രത്തിലെ പ്രക്രിയാനൈപുണികൾ അളക്കുന്നതിനുള്ള ഒരു പരീക്ഷയാണിത്. ഓരോ ചോദ്യത്തിനും നേരെ a, b, c, d എന്നിങ്ങനെ അക്ഷരങ്ങളിട്ട് നാല് ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ നിന്നും ശരിയുത്തരം കണ്ടുപിടിച്ച് ഉത്തരക്കടലാസിൽ ചോദ്യത്തിനു നേരെ കൊടുത്തിട്ടുള്ള ബോക്സിൽ രേഖപ്പെടുത്തുക. പരമാവധി ചുരുങ്ങിയ സമയത്തിനുള്ളിൽ ചോദ്യങ്ങൾക്ക് ഉത്തരം രേഖപ്പെടുത്തണം. ചോദ്യപേപ്പറിൽ ഒന്നും എഴുതുകയോ വരയ്ക്കുകയോ ചെയ്യരുത്

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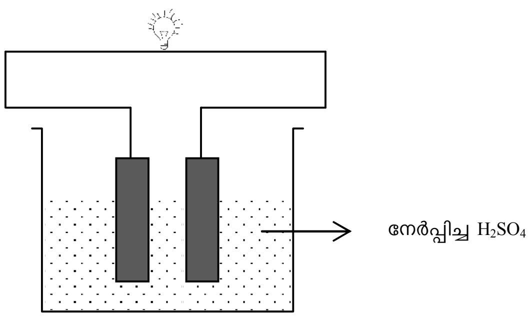
1. മണ്ണു കലക്കിയ ജലം, ചോക്കുപൊടി കലക്കിയ ജലം എന്നിവയിൽ നിന്ന് ജലം വേർതിരിക്കുവാൻ ഫിൽട്ടർ പേപ്പർ ഉപയോഗിക്കുവാൻ കാരണം.
   a. കണികകളുടെ വലിപ്പ വ്യത്യാസം
   b. ബാഷ്പീകരണ സ്വഭാവം
   c. കണികകളുടെ നിറം
   d. കാന്തിക സ്വഭാവം

2.



മുകളിലെ ചിത്രത്തിൽ നിന്നും ബൾബ് പ്രകാശിക്കുമ്പോൾ നടക്കുന്ന ഊർജമാറ്റം ഏതാണ്?

   a. താപോർജം $\rightarrow$ വൈദ്യുതോർജം
   b. പ്രകാശോർജം$\rightarrow$ വൈദ്യുതോർജം
   c. രാസോർജം $\rightarrow$ പ്രകാശോർജം
   d. കാന്തികോർജം $\rightarrow$ വൈദ്യുതോർജം

3. നീരാവി തട്ടിയുണ്ടാകുന്ന പൊള്ളൽ തിളച്ച വെള്ളം വീണുണ്ടാകുന്ന പൊള്ളലിനേ ക്കാൾ ഗുരുതരമാണ്. ഇതിന്റെ കാരണം എന്ത്?

   a. നീരാവിയിലെ ജലതന്മാത്രകൾ ഉയർന്ന മർദ്ദത്തിൽ സ്ഥിതി ചെയ്യുന്നത് കൊണ്ട് അത്രയും താപം വസ്തുവിൽ ഏൽക്കുന്നു.

   b. നീരാവി ഒരു വസ്തുവിൽ തട്ടി സാന്ദ്രീകരിച്ച് ജലമായി മാറുമ്പോൾ അത്രയും താപം വസ്തുവിൽ ഏൽപിക്കുന്നു.

   c. നീരാവിയിൽ ജലതന്മാത്രകൾ തമ്മിൽ അഡ്ഹിഷൻ ബലമായതിനാൽ കൂടുതൽ പൊള്ളുന്നു.

   d. നീരാവിയിൽ ജലതന്മാത്രകൾ തമ്മിൽ കൊഹിഷൻ ബലമായതിനാൽ കൂടുതൽ പൊള്ളുന്നു.

4. ജലത്തിന്റെ തന്മാത്രാഘടനയിൽനിന്നും അത് നിർമ്മിച്ചിരിക്കുന്ന ആറ്റങ്ങളുടെ അനുപാതം എങ്ങിനെയാണ്?

   a. 2 മൂലകങ്ങളും 3 ആറ്റങ്ങളും

   b. 2 മൂലകങ്ങളും 2 ആറ്റങ്ങളും

   c. 3 മൂലകങ്ങളും 2 ആറ്റങ്ങളും

   d. 3 മൂലകങ്ങളും 3 ആറ്റങ്ങളും

5. സ്വർണ്ണത്തിന്റെ ഉയർന്ന മൂല്യത്തിന് പുറമെ അതിനെ നേരിയ ലോഹമാക്കി അടിച്ച പരത്താൻ സാധിക്കുന്നു. ഇത്പോലെ ലോഹങ്ങളുടെ ഈ പ്രത്യേകതയെ എന്ത് വിളിക്കാം.

   a. മാലിയബിലിറ്റി

   b. ഡക്ടിലിറ്റി

   c. കണ്ടക്ടിവിറ്റി

   d. സോറോണിറ്റി

6. പെർഫ്യൂമിന്റെ കുപ്പി തുറന്ന് അല്പസമയത്തിന് ശേഷം റൂമിൽ മൊത്തമായി വ്യാപിക്കാറില്ലേ. ഈ പ്രക്രിയ എന്ത് പേരിലാണ് അറിയപ്പെടുന്നത്?

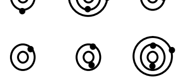
   a. സാന്ദ്രീകരണം

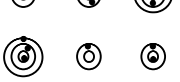
   b. ബാഷ്പീകരണം

   c. ഡിഫ്യൂഷൻ

   d. ഉത്പദനം

7. H^1, He^2, Li^3 എന്നീ ആറ്റങ്ങളുടെ ആറ്റോമിക നമ്പർ യഥാക്രമം 1, 2, 3 എന്നിവയാണ്. ഇവയെ ആറ്റോമിക നമ്പറിന്റെ ആരോഹണക്രമത്തിൽ ചിത്രീകരിച്ചിരിക്കുന്നത് ഏതിലാണ്?

   a. 

   b. 

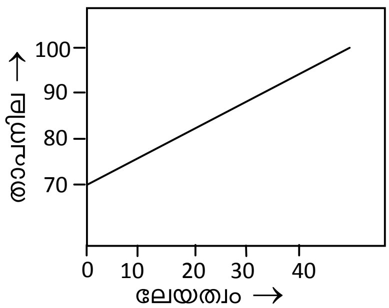
   c. 

   d. ഇവയൊന്നുമല്ല

8. ഇരുമ്പിന്റെയും അലുമിനിയത്തിന്റെയും കഷണങ്ങൾ എടുത്ത് പരുക്കൻ പ്രതലത്തിൽ ഉരസിയതിന് ശേഷം നിരീക്ഷിച്ചാൽ അത് തിളങ്ങുന്നതായി കാണാം. ലോഹങ്ങളുടെ ഈ ഗുണത്തിന്റെ പേരെന്ത്?

   a. ലോഹദ്യുതി
   b. മാലിയബിലിറ്റി
   c. ലോഹചാലകത
   d. ഡക്ടിലിറ്റി

9. താഴെ കൊടുത്തിരിക്കുന്ന ചിത്രത്തിൽ നിന്നും ലേയത്വവും താപനിലയും തമ്മിലുള്ള ബന്ധം എന്ത്?

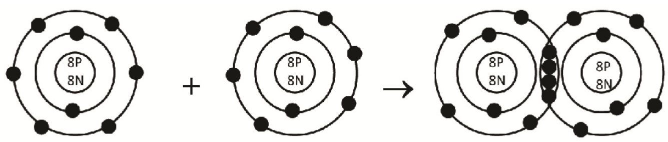


   a. താപനില കുറയുമ്പോൾ ലേയത്വം കൂടുന്നു
   b. താപനില കൂടുമ്പോൾ ലേയത്വം കൂടുന്നു
   c. താപനില സ്ഥിരമായിരിക്കുന്നു
   d. ഇവയൊന്നുമല്ല

10. ഇരുമ്പ് അടങ്ങിയിട്ടുള്ള ലോഹങ്ങൾ ചുറ്റുപാടുള്ള പദാർത്ഥങ്ങളുമായി പ്രവർത്തിച്ച് പുതിയ പദാർത്ഥം ഉണ്ടാകുന്ന പ്രവർത്തനങ്ങളെ എങ്ങിനെ നിർവ്വചിക്കാം.

   a. കൊറോഷൻ
   b. ഹൈഡ്രേഷൻ
   c. പോളിമറൈസേഷൻ
   d. എമൾഷൻ

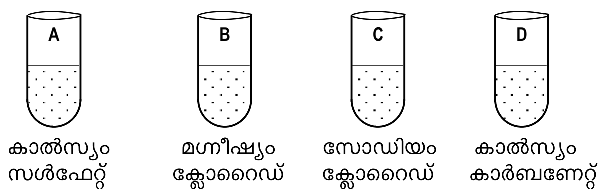
11.



മുകളിൽ കൊടുത്തിരിക്കന്ന ചിത്രത്തിന്റെ അടിസ്ഥാനത്തിൽ എത്ര ഇലക്ട്രോണുകളാണ് ഓരോ ഓക്സിജൻ ആറ്റവും പങ്കിടുന്നത്?

   a. 2
   b. 4
   c. 1
   d. 6

<u>വിവിധ പദാർത്ഥങ്ങൾ കലർന്ന ലായനികൾ നാല് ടെസ്റ്റ്യൂബുകളിലായി തന്നിരിക്കുന്നു. ഇത് നിരീക്ഷിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന ചോദ്യത്തിന് ഉത്തരം എഴുതുക?</u>



12. ഏത് ടെസ്റ്റ്യൂബിലെ ലായനിയിലാണ് സോപ്പ് പതയുന്നത്?

a. A
b. B
c. C
d. D

A, B എന്നീ ബീക്കറുകളിൽ പഞ്ചസാര ലായനികൾ തയ്യാറാക്കി വെച്ചിരിക്കുന്നു. രണ്ടിലേക്കും വീണ്ടും അല്പം പഞ്ചസാരകൂടി ചേർക്കുമ്പോൾ 'A' യിൽ ലയിക്കുന്നു B യിൽ ലയിക്കുന്നില്ല.

13. മേല്പറഞ്ഞ ലായനികളിൽ ലീനം ഏത്?

a. വെള്ളം
b. പഞ്ചസാര
c. പഞ്ചസാര ലായനി
d. ഇതൊന്നുമല്ല

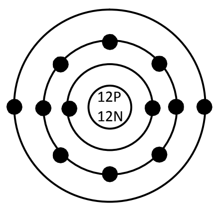
14. ലായകം ഏത്?

a. വെള്ളം
b. പഞ്ചസാര
c. പഞ്ചസാര ലായനി
d. ഇതൊന്നുമല്ല

15. 'B' എന്ന ബീക്കറിലെ ലായനിയെ എന്ത് വിളിക്കാം?

a. പൂരിതലായനി
b. ഖരലായനി
c. അതിപൂരിത ലായനി
d. എമൾഷൻ

16.



മെഗ്നീഷ്യത്തിന്റെ ബോർമാതൃക തന്നിരിക്കുന്നു. ഇതിൽ നിന്നും മെഗ്നീഷ്യത്തിന്റെ സംയോജകത എത്ര എന്നു കണ്ടുപിടിക്കുക.

a. 2
b. 1
c. 3
d. 4

17. ലിഥിയം എന്ന മൂലകത്തിന്റെ ബാഹ്യതമ ഷെല്ലിൽ ഒരു ഇലക്ട്രോൺ ഉണ്ട്. ലിഥിയം ആറ്റം സ്ഥിരത കൈവരിക്കുവാൻ എന്താണ് ചെയ്യുന്നത്.

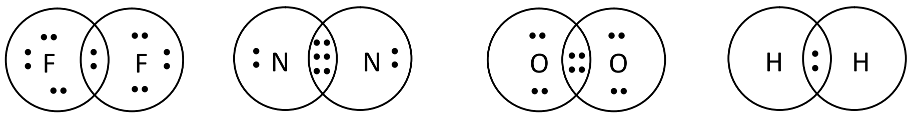
a. ഒരു ഇലക്ട്രോൺ സ്വീകരിക്കുന്നു
b. ഒരു ഇലക്ട്രോൺ വിട്ടുകൊടുക്കുന്നു
c. 3 ഇലക്ട്രോണുകളും വിട്ടുകൊടുക്കുന്നു
d. മൂലകത്തിന് ഇപ്പോൾ തന്നെ സ്ഥിരതയുണ്ട്.

18. ഓസോൺ പാളിയുടെ ശോഷണത്തിന് കാരണമാകുന്ന വാതകം ഏത്?

a. O_2
b. CFC
c. N_2
d. CO_2

19. ഒരു ജാറിൽ നിറമുള്ള പൂക്കൾ എടുത്തിരിക്കുന്നു എന്ന് വിചാരിക്കുക. പൂക്കളുടെ നിറം ഇല്ലാതാക്കാൻ സഹായിക്കുന്ന വാതകം ഏതായിരിക്കും?

a. ക്ലോറിൻ
b. ഫ്ളൂറിൻ
c. ബ്രോമിൻ
d. ഓക്സിജൻ



20. മുകളിലെ സംയുക്തങ്ങളിൽ കാണുന്ന ബന്ധനങ്ങൾക്ക് പൊതുവായി പറയുന്ന പേരെന്ത്?

a. സഹസംയോജക ബന്ധനം
b. ലോഹീയ ബന്ധനം
c. അയോണിക ബന്ധനം
d. സംയുക്ത ബന്ധനം

21. ദ്വിബന്ധനം കാണുന്നത് ഏത് മൂലകത്തിലാണ്?

a. ഫ്ളൂറിൻ
b. നൈട്രജൻ
c. ഓക്സിജൻ
d. ഹൈഡ്രജൻ

22. ത്രിബന്ധനം കാണുന്നത് ഏത് മൂലകത്തിൽ?

a. ഫ്ളൂറിൻ
b. നൈട്രജൻ
c. ഓക്സിജൻ
d. ഹൈഡ്രജൻ

23. സിങ്കും ഹൈഡ്രോക്ലോറിക് ആസിഡും തമ്മിൽ പ്രവർത്തിപ്പിച്ചപ്പോൾ ഒരു വാതകം ഉണ്ടായി. ഉണ്ടായ വാതകം ബലൂണിൽ നിറച്ച് കെട്ടിയ ശേഷം കൈവിട്ടപ്പോൾ ബലൂൺ ഉയർന്നുപോയി. വാതകം ഏതായിരിക്കും?

a. ഓക്സിജൻ
b. ഹൈഡ്രജൻ
c. നൈട്രജൻ
d. ആർഗൺ

24. നാലു ദ്രാവകങ്ങളുടെ തിളനിലകൾ തന്നിരിക്കുന്നു. താഴെ തന്നിരിക്കുന്ന ടേബിളിൽ നിന്നും ഏത് ദ്രാവകമാണ് ആദ്യം വാതകമാകുന്നത്

ദ്രാവകം	A	B	C	D
തിളനില	189^0C	183^0C	176^0C	195^0C

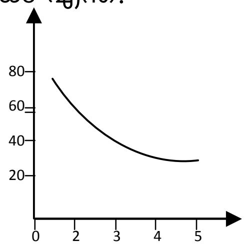
a. ദ്രാവകം A

b. ദ്രാവകം B

c. ദ്രാവകം C

d. ദ്രാവകം D

25. ഒരു നിശ്ചിത മാസ് വാതകത്തിന്റെ വിവിധ മർദ്ദങ്ങളിലുള്ള വ്യാപ്തം രേഖപ്പെടുത്തിയ ഗ്രാഫ് തന്നിരിക്കുന്നു. ഇതിൽ മർദ്ദവും വ്യാപ്തവും തമ്മിലുള്ള ബന്ധം എന്ത്?



a. വ്യാപ്തം കുറയുമ്പോൾ മർദ്ദം കൂടുന്നു

b. വ്യാപ്തം കൂടുമ്പോൾ മർദ്ദം കൂടുന്നു

c. വ്യാപ്തവും മർദ്ദവും തമ്മിൽ ബന്ധമില്ല

d. വ്യാപ്തവും താപനിലയും തമ്മിൽ ബന്ധമില്ല

26.

E		X		G
			J	
		L		

ചിത്രത്തിൽ E, X, G, J & L എന്നിവ അഞ്ച് മൂലകങ്ങളുടെ സ്ഥാനങ്ങളെ സൂചിപ്പിക്കുന്നു. ഇതിൽ 'X' എന്ന മൂലകത്തിന്റെ അറ്റോമിക നമ്പർ 'Z' ആണെങ്കിൽ 'Z+2' എന്നത് ഏത് മൂലകത്തിന്റെ അറ്റോമിക നമ്പർ ആയിരിക്കും

a. E

b. G

c. J

d. L

27. താഴെ കാണിച്ചിരിക്കുന്ന ജലസ്രോതസ്സുകളിൽ ഏതിനാണ് ആസിഡ് സ്വഭാവം കൂടുതൽ?

	ജല സ്രോതസ്സ്	pH
1.	മഴവെള്ളം	5.7
2.	തോട്ടിലെ വെള്ളം	7.9
3.	കുളത്തിലെ വെള്ളം	7.4
4.	ചെളിവെള്ളം	6.8

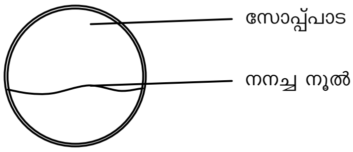
a. 1

b. 2

c. 3

d. 4

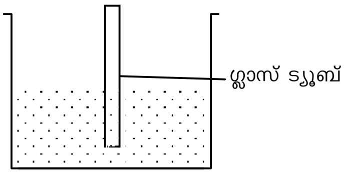
28.



ഒരു ലോഹത്തിൽ സോപ്പ് പാട ഉണ്ടാകിയിരിക്കുന്നു. ഇതിൽ നനച്ച ഒരു നൂൽ ചിത്രത്തിൽ കാണിച്ചിരിക്കുന്നത് പോലെ കെട്ടിവെയ്ക്കുന്നു. വിസ്തീർണ്ണം കുറഞ്ഞ ഭാഗത്തെ സോപ്പ് പാട പൊട്ടിക്കുമ്പോൾ എന്ത് സംഭവിക്കും?

a. സോപ്പ് പാട പൂർണ്ണമായും ഇല്ലാതാകുന്നു
b. വിസ്തീർണ്ണം കൂടിയ ഭാഗത്തെ സോപ്പ് പാട നിലനിൽക്കുന്നു.
c. നൂൽ പൊട്ടിപോകുന്നു
d. ലോഹ വളയത്തിൽ സോപ്പ് പാട ഉണ്ടാകുന്നില്ല

29.



ദ്രാവകത്തിൽ മുക്കിവെച്ചിരിക്കുന്നത് ഇതിലും വണ്ണം കുറഞ്ഞ ഗ്ലാസ് കുഴൽ ആയിരുന്നുവെങ്കിൽ കേശിക ഉയർച്ചയ്ക്ക് എന്ത് മാറ്റമാണ് ഉണ്ടാകുക.

a. കൂടുന്നു
b. കുറയുന്നു
c. മാറ്റമുണ്ടാകുന്നില്ല
d. വെള്ളം ട്യൂബിൽ കയറുന്നില്ല.

30. ഒരു വെളുത്ത തുണിയിൽ സിൽവർ നൈട്രേറ്റ് പുരട്ടിയ ശേഷം വെയിലത്ത് വെക്കുന്നു. അൽപ്പ സമയം കഴിഞ്ഞതിന് ശേഷം തുണിയിൽ സിൽവർ നൈട്രേറ്റ് പുരണ്ട ഭാഗം കറുത്ത നിറത്തിൽ കാണപ്പെടുന്നു. ഇതിന് സഹായിച്ച് ഊർജ്ജം ഏത്?

a. പ്രകാശം
b. താപം
c. രാസോർജം
d. വൈദ്യുതോർജം

31. ഒരു മൂലകത്തിന്റെ ഐസോടോപ്പുകളെ സംബന്ധിച്ച് താഴെ കൊടുത്തിരിക്കുന്ന പ്രസ്താവനകളിൽ തെറ്റായത് ഏത്?

a. പ്രോട്ടോണുകളുടെ എണ്ണം തുല്യം
b. ന്യൂട്രോണുകളുടെ എണ്ണം തുല്യം
c. രാസഗുണം തുല്യമായിരിക്കും
d. മാസ് നമ്പർ തുല്യമായിരിക്കും

32. ഗീതുവിന്റെ വീട്ടിലെ ചെമ്പുപാത്രങ്ങൾ ക്രമേണ കറുത്ത് വരുന്നതായും എന്നാൽ സ്റ്റീൽ പാത്രങ്ങൾക്ക് യാതൊരു മാറ്റവും സംഭവിക്കുന്നില്ലെന്ന് കണ്ടെത്തി. ഈ മാറ്റം നടക്കുന്നതിന് ഗീതു കണ്ടെത്തിയ കാരണം എന്തായിരിക്കും?

a. ഓക്സിജനുമായി പ്രവർത്തിച്ച് കോപ്പർ ഓക്സൈഡ് ഉണ്ടാകുന്നതിനാൽ
b. വായുവിലുള്ള സൾഫറുമായി പ്രവർത്തിച്ച് സൾഫേറ്റുകൾ ഉണ്ടാകുന്നതിനാൽ

c. ചെമ്പുപാത്രങ്ങളിൽ നിർമ്മാണസമയത്ത് വിലകുറഞ്ഞ ലോഹങ്ങൾ കൂട്ടിച്ചേർക്കുന്നത്കൊണ്ട്.

d. ചെമ്പുപാത്രങ്ങൾ പുളിയും ചാരവുമുപയോഗിച്ച് കഴുകുന്നത്കൊണ്ട്.

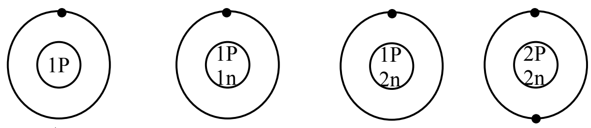
33. താഴെ കൊടുത്തിരിക്കുന്ന ഏത് സന്ദർഭത്തിലാണ് ഒരാറ്റം നെഗറ്റീവ് അയോണായി മാറുന്നത്?

a. ഇലക്ട്രോൺ ലഭിക്കുമ്പോൾ
b. ഇലക്ട്രോൺ നഷ്ടപ്പെടുമ്പോൾ
c. പ്രോട്ടോൺ നഷ്ടപ്പെടുമ്പോൾ
d. പ്രോട്ടോൺ ലഭിക്കുമ്പോൾ

34. ഓരോ ഷെല്ലിലും ഉൾക്കൊള്ളാൻ കഴിയുന്ന പരമാവധി ഇലക്ട്രോണുകളുടെ എണ്ണം കണ്ടുപിടിക്കുന്നതിനുള്ള സൂത്രവാക്യം ഏത്?

a. $2n^1$
b. $2n^2$
c. $2n^3$
d. $2n$

<u>ഹൈഡ്രജൻ പ്രകൃതിയിൽ കണ്ടുവരുന്ന വ്യത്യസ്ത രൂപങ്ങൾ ചിത്രീകരിച്ചിരിക്കുന്നു.</u>



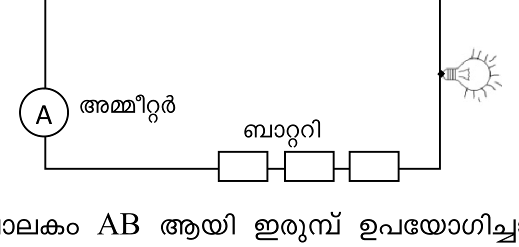
35. ഹൈഡ്രജന്റെ ഈ സവിശേഷത ഏത് പേരിലറിയപ്പെടുന്നു?

a. ഐസോടോപ്പ്
b. ഐസോടോൺ
c. ഐസോമെർ
d. ഐസോബാർ

36. ഒരു മൂലകത്തിന്റെ മാസ് നമ്പർ 4ഉം ആറ്റോമിക നമ്പർ 7ഉം ആണെങ്കിൽ അതിലെ പ്രോട്ടോൺ, ന്യൂട്രോൺ, ഇലക്ട്രോൺ എന്നിവയുടെ എണ്ണം യാഥാക്രമം താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏതാണ്?

a. 14, 7, 7
b. 7, 14, 7
c. 7, 7, 14
d. 7, 7, 7

37.



ചാലകം AB ആയി ഇരുമ്പ് ഉപയോഗിച്ചാൽ ബൾബിന്റെ പ്രകാശ തീവ്രതയിൽ ഉണ്ടാകുന്ന വ്യത്യാസം എന്ത്?

a. പ്രകാശതീവ്രത കൂടുന്നു
b. പ്രകാശതീവ്രത കുറയുന്നു
c. ഒരു മാറ്റവുമില്ല
d. ബൾബ് പ്രകാശിക്കുന്നില്ല

38. വെളിച്ചെണ്ണ, ജലം എന്നിവ തുല്യ അളവിൽ രണ്ടു ബീക്കറുകളിലായി എടുത്ത് ഒരേ വാട്ടർബാത്തിൽ വച്ച് ചൂടാക്കുന്നു. നിശ്ചിതസമയം കഴിഞ്ഞപ്പോൾ ഒരു ദ്രാവകത്തിന്റെ താപനില മറ്റേതിന്റെ ഇരട്ടിയോളം ഉയർന്നതായി കണ്ടു. താപനില ഉയർന്ന ദ്രാവകം ഏത്?

a. ജലം
b. വെളിച്ചെണ്ണ
c. ജലത്തിനും വെളിച്ചെണ്ണയ്ക്കും താപനില തുല്യം
d. ഇതൊന്നുമല്ല

39. താഴെ കൊടുത്തിരിക്കുന്ന രാസപ്രവർത്തനം താപമോചകപ്രവർത്തനമാണെന്ന് സൂചിപ്പി ക്കുന്ന പ്രസ്താവന എത്?

$2H_2(g) + O_2\,(g) \rightarrow 2H_2O\ (l) + 571.6\ KJ$

a. ഊർജ്ജം പുറന്തള്ളപ്പെടുന്നു
b. സംയുക്തം രൂപപ്പെടുന്നു
c. അഭികാരകങ്ങൾ വാതകാവസ്ഥയിലാണ്
d. ഉല്പന്നങ്ങളേക്കാൾ കൂടുതൽ അഭികാരകങ്ങൾ ഉണ്ട്

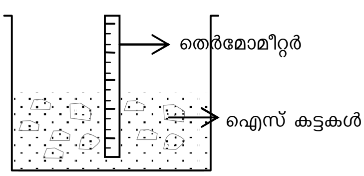
40. സാധാരണ ഊഷ്മാവിലുള്ള ജലം ബീക്കറിലെടുത്ത് ഭാരം കുറഞ്ഞ നാണയം ജലോപരിതലത്തിൽ വെച്ചാൽ പൊങ്ങികിടക്കുന്നു. എന്നാൽ സോപ്പ് കലക്കിയ ജലമാണെങ്കിൽ നാണയം താഴ്ന്ന് പോകുന്നു. ഇതിന് കാരണമായ പ്രതിഭാസം ഏത്?

a. കേശികത്വം
b. പ്രതലബലം
c. വിസ്കോസിറ്റി
d. അഡിഷൻ

41. **കാർബൺഡൈ ഓക്സൈഡ്, മെർക്കുറി, നൈട്രജൻ, കാർബൺ** ഈ ഗ്രൂപ്പിൽ സംയുക്തം ഏത്?

a. കാർബൺഡൈ ഓക്സൈഡ്
b. മെർക്കുറി
c. നൈട്രജൻ
d. കാർബൺ

ഒരു ബീക്കറിൽ ഐസ് കട്ടകളെടുത്ത് അതിൽ ഒരു തെർമോമീറ്റർ സാധാരണ ഊഷ്മാവിൽ വച്ചിരിക്കുന്ന ചിത്രം കാണിച്ചിരിക്കുന്നു.



42. അവസ്ഥാമാറ്റം നടക്കുമ്പോൾ തെർമോമീറ്ററിലെ താപനിലയിൽ ഉണ്ടാകുന്ന മാറ്റം എന്ത്?

a. കുറയുന്നു
b. കൂടുന്നു
c. താപനില സ്ഥിരമായി നിൽക്കുന്നു
d. ആദ്യം കുറയുന്നു പിന്നീട് കൂടുന്നു.

43. ഒരു ഖരം ദ്രാവകാവസ്ഥ പ്രാപിക്കുന്ന സ്ഥിരതാപനില ഏത് പേരിലാണ് അറിയപ്പെടുന്നത്?

a. തിളനില
b. ഖരനില
c. ദ്രവനില
d. താപനില

Appendix- E2

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

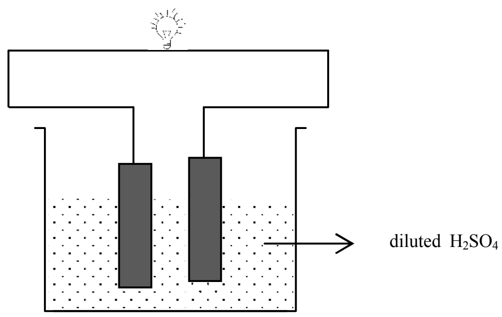
TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY
(Draft)

Dr. A. Hameed — Assistant Professor

Meharunnisa Karadan — Research Scholar

Instructions: This test is to measure the process skills in chemistry. For each questions four options a, b, c, d are given. After reading each questions carefully, identify the correct answer and mark on the appropriate box in the answer sheet provided. Answer the questions in less than one minute. Don't write or draw anything on the question paper.

1. What is the reason for using filter paper for separating water from the mixtures of water and mud, water and choak
   a. Difference in size of the particles
   b. Property of evaporation
   c. Colour of particles
   d. Magnetic property

2. 

   From the above picture, what is the energy change taken place while glowing a bulb?
   a. Heat energy→ Electrical energy
   b. Light energy→ Electrical energy
   c. Chemical energy → Light energy
   d. Magnetic energy → Electrical energy

3. The burn caused by vapour is severe than burn caused by hot water. Why?
   a. Water molecules in vapour are in high pressure and the thing affected by more heat.
   b. When vapour condenses in to water it affects more heat on the thing.

c. In vapour state the force of attraction in water molecules are adhesion and it cause more burn.

d. In vapour state the force of attraction in water molecules are cohesion and it cause more burn.

4. Analyse the ratio of atoms in the molecular structure of water

a. 2 elements and 3 atoms

b. 2 elements and 2 atoms

c. 3 elements and 2 atoms

d. 3 elements and 3 atoms

5. Besides being valuable, gold is special because it can be hammered in to a very thin foil. This property of metal is generally called as

a. Malliability

b. Ductility

c. Conductivity

d. Soronity

6. When we open a bottle of perfume its smell will spread throughout the room. This property is know by the name.

a. Condensation

b. Evaporation

c. Diffusion

d. Sublimation

7. Atoms H^1, He^2, Li^3 having atomic numbers 1, 2, 3 respectively. Which picture represents ascending order in atomic number of the above atoms?

a. 

b. 

c. 

d. None of these

8. If you scratch two pieces of aluminum and iron in a rough place, you can see bright glows on it. This property of metals is called

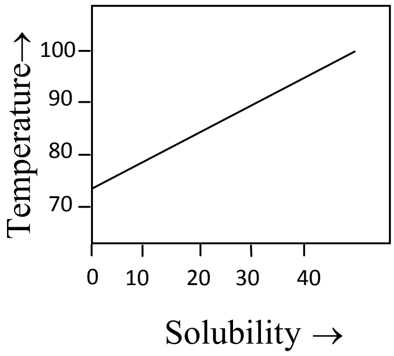
a. Metallic luster

b. Malliability

c. Metallic conductivity

d. Ductility

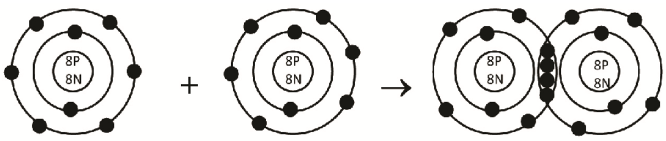
9. From the picture below, what is the relationship between solubility and temperature?



a. Solubility increases when temperature decrease
b. Solubility increase when temperature increases
c. Solubility remains constant
d. None of these

10. Metals which contain iron reacts with other substances in the surroundings and produces new substances. This process can be operationally defined as
a. Corrosion
b. Hydration
c. Polymerization
d. Emulsion

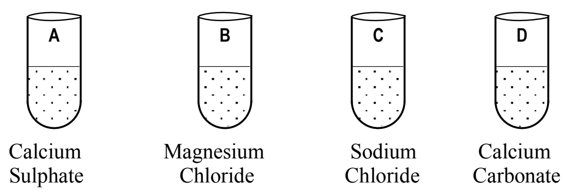
11.



On the basis of the above picture how many electrons are shared by each oxygen atom?

a. 2
b. 4
c. 1
d. 6

Four test tubes are given with solutions of different substances. By observing these test tubes find out answer for the following two questions?



12. In which test tube foam is created when adding soap?

   a. A
   b. B
   c. C
   d. D

Suppose two beakers A and B contains solutions of sugar. When we add little sugar in to both of these breakers, it will soluble in beaker 'A' but not soluble in beaker 'B'.

13. In the above solutions which is solute?

   a. Water
   b. Sugar
   c. Sugar solution
   d. None of these

14. Which is the solvent?

   a. Water
   b. Sugar
   c. Sugar solution
   d. None of these

15. What we call the solution of the beaker 'B'

   a. Saturated solution
   b. Solid solution
   c. Super saturated solution
   d. Emulsion

16.

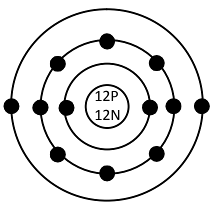
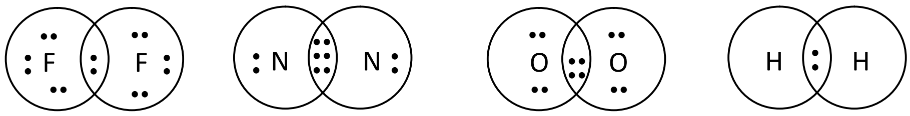


Image represents the Bohr model of the element magnesium. From this find out the valency of magnesium?

   a. 2
   b. 1
   c. 3
   d. 4

17. Outermost shell of lithium contains one electron. For getting stability what lithium atom do?
    a. Accepts on electron
    b. Withdraws one electron
    c. Withdraws three electrons
    d. Elements itself has stability
18. Which of the gas cause ozone depletion?
    a. O_2
    b. CFC
    c. N_2
    d. CO_2
19. Suppose, a jar contains flowers with different colours. Which gas may helps to remove the colour of flowers?
    a. Chlorine
    b. Flourine
    c. Bromine
    d. Oxygen



20. What is the name of chemical bond that seen in the above compounds?
    a. Covalent bond
    b. Metallic bond
    c. Ionic bond
    d. Compound bond
21. Which element has double bond?
    a. Fluorine
    b. Nitrogen
    c. Oxygen
    d. Hydrogen
22. Which element contain triple bond?
    a. Flourine
    b. Nitrogen
    c. Oxygen
    d. Hydrogen

23. When zinc and hydrogen reacted together produce a gas, which when filled in a Balloon it flies up. Do you guess what is the gas inside the Balloon?

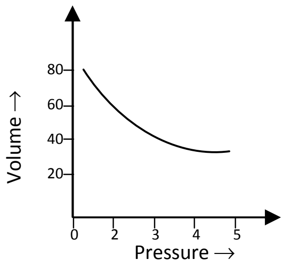
    a. Oxygen
    b. Hydrogen
    c. Nitrogen
    d. Argon

24. Boiling points of four liquids are given. From the table given below identify the element which vapourises first?

Liquid	A	B	C	D
Boiling Point	$189^{0}C$	$183^{0}C$	$176^{0}C$	$195^{0}C$

    a. Liquid A
    b. Liquid B
    c. Liquid C
    d. Liquid D

25. Graphical representation of a gas with a specific weight with its volume at different pressure are given. Find out the relation between pressure and volume?



    a. Pressure increase when volume decreases
    b. Pressure increase when volume increases
    c. No relation between volume and pressure
    d. No relation between volume and temperature

26.

E		X		G
			J	
		L		

In the picture E, X, G, J & L indicates positions of five elements. If atomic number of 'X' is 'Z', identify the element having atomic number of 'Z+2'.

    a. E
    b. G
    c. J
    d. L

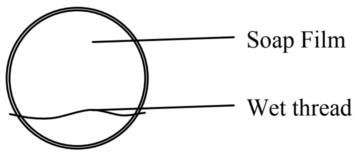
27. From the box identify water sources which is more acidic?

	Water	P^H
1.	Rain water	5.7
2.	Sea water	7.9
3.	Pond water	7.4
4.	Muddy water	6.8

a. 1 c. 3

b. 2 d. 4

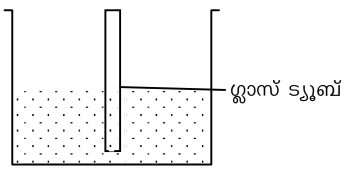
28.



A soap film is made in metal. A wet thread is tied in that like shown in the picture. What will happens if destroying the soap film in the lesser area part?

a. Soap film completely vanishes
b. The soap film in the larger area remains and it shrinks
c. The thread cuts off
d. No soap film is made on the metal circle

29.



If the glass tube immersed in the liquid is thinner than seen in picture, what change would happen, to the capillary rise?

a. Increases
b. Decreases
c. No change
d. Water doesn't in to the tube

30. A white cloth, after applying silver nitrate, puts under sunlight. After sometime, the area which silver nitrate had applied appears to be black in colour. Which energy is responsible for this?

a. Light
b. Heat
c. Chemical energy
d. Electric energy

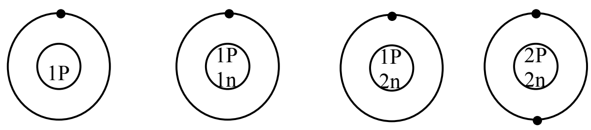
31. Pick out the wrong statement about the isotopes of an element.
    a. Equal number of protons
    b. Equal number of electrons
    c. Chemical properties are same
    d. Mass number is same

32. Geethu noticed that copper utensils in her home gradually turn black in colour where as the steel utensils remain as such. The reason discovered by Geethu for this change is
    a. Reacts with oxygen and produces copper oxide
    b. Reacts with sulphur in the air and produces sulphates
    c. Adding cheap metals to the copper vessels during manufacturing
    d. Cleaning copper vessels using ashes tamerind

33. On what circumstances an atom became a negative ion?
    a. Gain electron
    b. Loss electron
    c. Loss proton
    d. Gain proton

34. What is the equation for calculating maximum number of electrons occupy in a particular shell?
    a. $2n^1$
    b. $2n^2$
    c. $2n^3$
    d. 2n

35. Different forms of hydrogen in nature is picturised below, what is the name of this property?

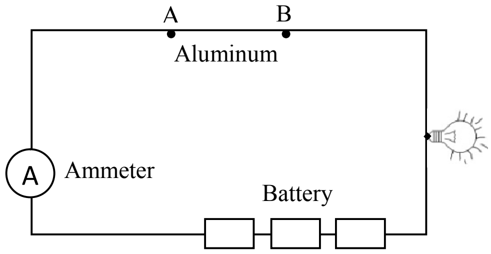


A B C D

    a. Isotope
    b. Isotone
    c. Isoner
    d. Isobar

36. Mass number of an element is 14 and atomic number '7'. Write down the number of protons, neutrons, electrons respectively of the element?
    a. 14, 7, 7
    b. 7, 14, 7
    c. 7, 7, 14
    d. 7, 7, 7

37.



If iron is used as conductor ‘AB’ what difference occur in the intensity of lighting of bulb?

a. Intensity of light increases
b. Intensity of light decreases
c. No change
d. Bulb is not glowing

38. Take a fixed amount of coconut oil and water in two beakers and heated each on the same water batch. After a specific time temperature of one liquid is found to be doubled. Identify the liquid with high temperature.

a. Water
b. Coconut Oil
c. Temperature of water and coconut are same
d. None of these

39. Which of the statements indicates that following reaction is an exothermic reaction?

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) + 571.6\ KJ$

a. Energy released
b. Compound is formed
c. Reactants are in gaseous state
d. Reactants are more than products

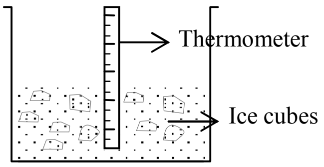
40. When a low weight coin is placed on the surface of water at normal temperature in a beaker, it floats, but when it is placed above the soap water it drawns. What is the reason for this phenomenon?

a. Capillarity
b. Surface tension
c. Viscosity
d. Adhesion

41. **Carbon dioxide, Mercury, Nitrogen, Carbon** pick out compound from the box

a. CO_2
b. Mercury
c. Nitrogen
d. Carbon

Picture shows some ice cubes are taken a beaker and put a thermo meter in it.



42. During change in state, the temperature of thermometer?

a. Decrease
b. Increase
c. Temperature become constant
d. First decreases then increases

43. Name the temperature at which a solid becomes a liquid?

a. Boiling point
b. Freezing point
c. Melting point
d. Temperature

Appendix- E3

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY
(Draft)

Scoring Key

Ques. No.	Answer
1	a
2	c
3	a
4	a
5	a
6	c
7	b
8	a
9	b
10	a
11	c
12	d
13	b
14	a
15	c

Ques. No.	Answer
16	b
17	b
18	b
19	a
20	a
21	c
22	b
23	b
24	d
25	a
26	b
27	a
28	b
29	a
30	a

Ques. No.	Answer
31	a
32	a
33	a
34	b
35	a
36	d
37	a
38	b
39	a
40	b
41	a
42	b
43	c

Appendix- E4

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY
(Final)

Dr. A. Hameed — Assistant Professor
Meharunnisa Karadan — Research Scholar

നിർദ്ദേശങ്ങൾ:

രസതന്ത്രത്തിലെ പ്രക്രിയാനൈപുണികൾ അളക്കുന്നതിനുള്ള ഒരു പരീക്ഷ യാണിത്. ഓരോ ചോദ്യത്തിനും നേരെ a, b, c, d എന്നിങ്ങനെ അക്ഷരങ്ങളിട്ട് നാല് ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് അതിൽ നിന്നും ശരിയുത്തരം കണ്ടുപിടിച്ച് ഉത്തരക്കടലാസിൽ ചോദ്യത്തിനു നേരെ കൊടു ത്തിട്ടുള്ള ബോക്സിൽ രേഖപ്പെടുത്തുക. പരമാവധി ചുരുങ്ങിയ സമയത്തിനുള്ളിൽ ചോദ്യങ്ങൾക്ക് ഉത്തരം രേഖപ്പെടുത്തണം. ചോദ്യപേപ്പറിൽ ഒന്നും എഴുതുകയോ വരയ്ക്കുകയോ ചെയ്യരുത്

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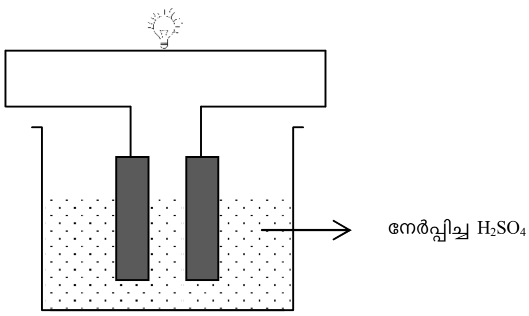
1. മണ്ണു കലക്കിയ ജലം, ചോക്കുപൊടി കലക്കിയ ജലം എന്നിവയിൽ നിന്ന് ജലം വേർതിരിക്കുവാൻ ഫിൽട്ടർ പേപ്പർ ഉപയോഗിക്കുവാൻ കാരണം.

   a. കണികകളുടെ വലിപ്പ വ്യത്യാസം
   b. ബാഷ്പീകരണ സ്വഭാവം
   c. കണികകളുടെ നിറം
   d. കാന്തിക സ്വഭാവം

2.



മുകളിലെ ചിത്രത്തിൽ നിന്നും ബൾബ് പ്രകാശിക്കുമ്പോൾ നടക്കുന്ന ഊർജമാറ്റം ഏതാണ്?

   a. താപോർജം $\rightarrow$ വൈദ്യുതോർജം
   b. പ്രകാശോർജം$\rightarrow$ വൈദ്യുതോർജം
   c. രാസോർജം $\rightarrow$ പ്രകാശോർജം
   d. കാന്തികോർജം $\rightarrow$ വൈദ്യുതോർജം

3. ജലത്തിന്റെ തന്മാത്രാഘടനയിൽനിന്നും അത് നിർമ്മിച്ചിരിക്കുന്ന ആറ്റങ്ങളുടെ അനുപാതം എങ്ങിനെയാണ്?

   a. 2 മൂലകങ്ങളും 3 ആറ്റങ്ങളും
   b. 2 മൂലകങ്ങളും 2 ആറ്റങ്ങളും
   c. 3 മൂലകങ്ങളും 2 ആറ്റങ്ങളും
   d. 3 മൂലകങ്ങളും 3 ആറ്റങ്ങളും

4. സ്വർണ്ണത്തിന്റെ ഉയർന്ന മൂല്യത്തിന് പുറമെ അതിനെ നേരിയ ലോഹമാക്കി അടിച്ച പരത്താൻ സാധിക്കുന്നു. ഇത്പോലെ ലോഹങ്ങളുടെ ഈ പ്രത്യേകതയെ എന്ത് വിളിക്കാം.

   a. മാലിയബിലിറ്റി
   b. ഡക്ടിലിറ്റി
   c. കണ്ടക്ടിവിറ്റി
   d. സോറോണിറ്റി

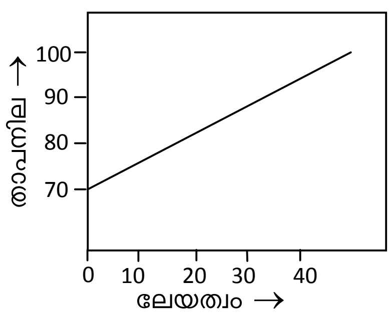
5. H^1, He^2, Li^3 എന്നീ ആറ്റങ്ങളുടെ ആറ്റോമിക നമ്പർ യഥാക്രമം 1, 2, 3 എന്നിവയാണ്. ഇവയെ ആറ്റോമിക നമ്പറിന്റെ ആരോഹണക്രമത്തിൽ ചിത്രീകരിച്ചിരിക്കുന്നത് ഏതിലാണ്?

   a. 
   b. 
   c. 
   d. ഇവയൊന്നുമല്ല

6. ഇരുമ്പിന്റെയും അലുമിനിയത്തിന്റെയും കഷണങ്ങൾ എടുത്ത് പരുക്കൻ പ്രതലത്തിൽ ഉരസിയതിന് ശേഷം നിരീക്ഷിച്ചാൽ അത് തിളങ്ങുന്നതായി കാണാം. ലോഹങ്ങളുടെ ഈ ഗുണത്തിന്റെ പേരെന്ത്?

   a. ലോഹദ്യുതി
   b. മാലിയബിലിറ്റി
   c. ലോഹചാലകത
   d. ഡക്ടിലിറ്റി

7. താഴെ കൊടുത്തിരിക്കുന്ന ചിത്രത്തിൽ നിന്നും ലേയത്വവും താപനിലയും തമ്മിലുള്ള ബന്ധം എന്ത്?



   a. താപനില കുറയുമ്പോൾ ലേയത്വം കൂടുന്നു
   b. താപനില കൂടുമ്പോൾ ലേയത്വം കൂടുന്നു
   c. താപനില സ്ഥിരമായിരിക്കുന്നു
   d. ഇവയൊന്നുമല്ല

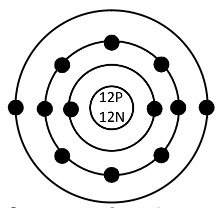
8. ഇരുമ്പ് അടങ്ങിയിട്ടുള്ള ലോഹങ്ങൾ ചുറ്റുപാടുള്ള പദാർത്ഥങ്ങളുമായി പ്രവർത്തിച്ച് പുതിയ പദാർത്ഥം ഉണ്ടാകുന്ന പ്രവർത്തനങ്ങളെ എങ്ങിനെ നിർവ്വചിക്കാം.
   a. കൊറോഷൻ
   b. ഹൈഡ്രേഷൻ
   c. പോളിമറൈസേഷൻ
   d. എമൾഷൻ

<u>A, B എന്നീ ബീക്കറുകളിൽ പഞ്ചസാര ലായനികൾ തയ്യാറാക്കി വെച്ചിരിക്കുന്നു. രണ്ടിലേക്കും വീണ്ടും അല്പം പഞ്ചസാരകൂടി ചേർക്കുമ്പോൾ 'A' യിൽ ലയിക്കുന്നു B യിൽ ലയിക്കുന്നില്ല.</u>

9. മേല്പറഞ്ഞ ലായനികളിൽ ലീനം ഏത്?
   a. വെള്ളം
   b. പഞ്ചസാര
   c. പഞ്ചസാര ലായനി
   d. ഇതൊന്നുമല്ല

10. 'B' എന്ന ബീക്കറിലെ ലായനിയെ എന്ത് വിളിക്കാം?
   a. പൂരിതലായനി
   b. ഖരലായനി
   c. അതിപൂരിത ലായനി
   d. എമൾഷൻ

11.



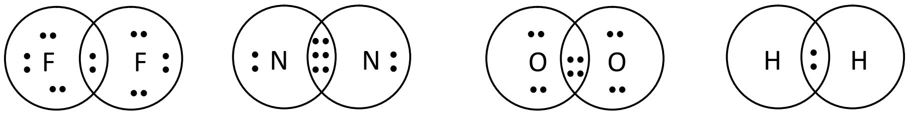
മെഗ്നീഷ്യത്തിന്റെ ബോർമാതൃക തന്നിരിക്കുന്നു. ഇതിൽ നിന്നും മെഗ്നീഷ്യത്തിന്റെ സംയോജകത എത്ര എന്നു കണ്ടുപിടിക്കുക.
   a. 2
   b. 1
   c. 3
   d. 4

12. ലിഥിയം എന്ന മൂലകത്തിന്റെ ബാഹ്യതമ ഷെല്ലിൽ ഒരു ഇലക്ട്രോൺ ഉണ്ട്. ലിഥിയം ആറ്റം സ്ഥിരത കൈവരിക്കുവാൻ എന്താണ് ചെയ്യുന്നത്.
   a. ഒരു ഇലക്ട്രോൺ സ്വീകരിക്കുന്നു
   b. ഒരു ഇലക്ട്രോൺ വിട്ടുകൊടുക്കുന്നു
   c. 3 ഇലക്ട്രോണുകളും വിട്ടുകൊടുക്കുന്നു
   d. മൂലകത്തിന് ഇപ്പോൾ തന്നെ സ്ഥിരതയുണ്ട്.

13. ഓസോൺ പാളിയുടെ ശോഷണത്തിന് കാരണമാകുന്ന വാതകം ഏത്?
   a. O_2
   b. CFC
   c. N_2
   d. CO_2

14. ഒരു ജാറിൽ നിറമുള്ള പൂക്കൾ എടുത്തിരിക്കുന്നു എന്ന് വിചാരിക്കുക. പൂക്കളുടെ നിറം ഇല്ലാതാക്കാൻ സഹായിക്കുന്ന വാതകം ഏതായിരിക്കും?

 a. ക്ലോറിൻ
 b. ഫ്‌ളൂറിൻ
 c. ബ്രോമിൻ
 d. ഓക്സിജൻ



15. മുകളിലെ സംയുക്തങ്ങളിൽ കാണുന്ന ബന്ധനങ്ങൾക്ക് പൊതുവായി പറയുന്ന പേരെന്ത്?

 a. സഹസംയോജക ബന്ധനം
 b. ലോഹീയ ബന്ധനം
 c. അയോണിക ബന്ധനം
 d. സംയുക്ത ബന്ധനം

16. ദ്വിബന്ധനം കാണുന്നത് ഏത് മൂലകത്തിലാണ്?

 a. ഫ്‌ളൂറിൻ
 b. നൈട്രജൻ
 c. ഓക്സിജൻ
 d. ഹൈഡ്രജൻ

17. ത്രിബന്ധനം കാണുന്നത് ഏത് മൂലകത്തിൽ?

 a. ഫ്‌ളൂറിൻ
 b. നൈട്രജൻ
 c. ഓക്സിജൻ
 d. ഹൈഡ്രജൻ

18. സിങ്കും ഹൈഡ്രോക്ലോറിക് ആസിഡും തമ്മിൽ പ്രവർത്തിപ്പിച്ചപ്പോൾ ഒരു വാതകം ഉണ്ടായി. ഉണ്ടായ വാതകം ബലൂണിൽ നിറച്ച് കെട്ടിയ ശേഷം കൈവിട്ടപ്പോൾ ബലൂൺ ഉയർന്നുപോയി. വാതകം ഏതായിരിക്കും?

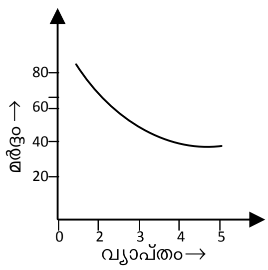
 a. ഓക്സിജൻ
 b. ഹൈഡ്രജൻ
 c. നൈട്രജൻ
 d. ആർഗൺ

19. നാലു ദ്രാവകങ്ങളുടെ തിളനിലകൾ തന്നിരിക്കുന്നു. താഴെ തന്നിരിക്കുന്ന ടേബിളിൽ നിന്നും ഏത് ദ്രാവകമാണ് ആദ്യം വാതകമാകുന്നത്

ദ്രാവകം	A	B	C	D
തിളനില	189^0C	183^0C	176^0C	195^0C

 a. ദ്രാവകം A
 b. ദ്രാവകം B
 c. ദ്രാവകം C
 d. ദ്രാവകം D

20. ഒരു നിശ്ചിത മാസ് വാതകത്തിന്റെ വിവിധ മർദ്ദങ്ങളിലുള്ള വ്യാപ്തം രേഖപ്പെടുത്തിയ ഗ്രാഫ് തന്നിരിക്കുന്നു. ഇതിൽ മർദ്ദവും വ്യാപ്തവും തമ്മിലുള്ള ബന്ധം എന്ത്?



a. വ്യാപ്തം കുറയുമ്പോൾ മർദ്ദം കൂടുന്നു
b. വ്യാപ്തം കൂടുമ്പോൾ മർദ്ദം കൂടുന്നു
c. വ്യാപ്തവും മർദ്ദവും തമ്മിൽ ബന്ധമില്ല
d. വ്യാപ്തവും താപനിലയും തമ്മിൽ ബന്ധമില്ല

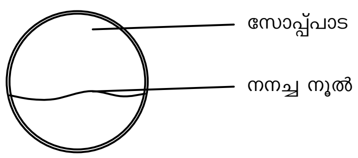
21.

E		X		G
			J	
		L		

ചിത്രത്തിൽ E, X, G, J & L എന്നിവ അഞ്ച് മൂലകങ്ങളുടെ സ്ഥാനങ്ങളെ സൂചിപ്പിക്കുന്നു. ഇതിൽ ‘X’ എന്ന മൂലകത്തിന്റെ അറ്റോമിക നമ്പർ ‘Z’ ആണെങ്കിൽ ‘Z+2’ എന്നത് ഏത് മൂലകത്തിന്റെ അറ്റോമിക നമ്പർ ആയിരിക്കും

a. E
b. G
c. J
d. L

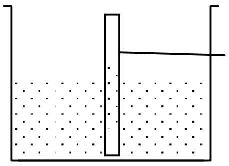
22.



ഒരു ലോഹത്തിൽ സോപ്പ് പാട ഉണ്ടാകിയിരിക്കുന്നു. ഇതിൽ നനച്ച ഒരു നൂൽ ചിത്രത്തിൽ കാണിച്ചിരിക്കുന്നത് പോലെ കെട്ടിവെയ്ക്കുന്നു. വിസ്തീർണ്ണം കുറഞ്ഞ ഭാഗത്തെ സോപ്പ് പാട പൊട്ടിക്കുമ്പോൾ എന്ത് സംഭവിക്കും?

a. സോപ്പ് പാട പൂർണ്ണമായും ഇല്ലാതാകുന്നു
b. വിസ്തീർണ്ണം കൂടിയ ഭാഗത്തെ സോപ്പ് പാട നിലനിൽക്കുന്നു.
c. നൂൽ പൊട്ടിപോകുന്നു
d. ലോഹ വളയത്തിൽ സോപ്പ് പാട ഉണ്ടാകുന്നില്ല

23.



ദ്രാവകത്തിൽ മുക്കിവെച്ചിരിക്കുന്നത് ഇതിലും വണ്ണം കുറഞ്ഞ ഗ്ലാസ് കുഴൽ ആയിരുന്നുവെങ്കിൽ കേശിക ഉയർച്ചയ്ക്ക് എന്ത് മാറ്റമാണ് ഉണ്ടാകുക.

a. കൂടുന്നു
b. കുറയുന്നു
c. മാറ്റമുണ്ടാകുന്നില്ല
d. വെള്ളം ട്യൂബിൽ കയറുന്നില്ല.

24. ഒരു വെളുത്ത തുണിയിൽ സിൽവർ നൈട്രേറ്റ് പുരട്ടിയ ശേഷം വെയിലത്ത് വെക്കുന്നു.അൽപ്പസമയം കഴിഞ്ഞതിന് ശേഷം തുണിയിൽ സിൽവർ നൈട്രേറ്റ് പുരണ്ട ഭാഗം കറുത്ത നിറത്തിൽ കാണപ്പെടുന്നു. ഇതിന് സഹായിച്ച് ഊർജ്ജം ഏത്?

a. പ്രകാശം
b. താപം
c. രാസോർജം
d. വൈദ്യുതോർജം

25. ഗീതുവിന്റെ വീട്ടിലെ ചെമ്പുപാത്രങ്ങൾ ക്രമേണ കറുത്ത് വരുന്നതായും എന്നാൽ സ്റ്റീൽ പാത്രങ്ങൾക്ക് യാതൊരു മാറ്റവും സംഭവിക്കുന്നില്ലെന്ന് കണ്ടെത്തി. ഈ മാറ്റം നടക്കുന്നതിന് ഗീതു കണ്ടെത്തിയ കാരണം എന്തായിരിക്കും?

a. ഓക്സിജനുമായി പ്രവർത്തിച്ച് കോപ്പർ ഓക്സൈഡ് ഉണ്ടാകുന്നതിനാൽ
b. വായുവിലുള്ള സൾഫറുമായി പ്രവർത്തിച്ച് സൾഫേറ്റുകൾ ഉണ്ടാകുന്നതിനാൽ
c. ചെമ്പുപാത്രങ്ങളിൽ നിർമ്മാണസമയത്ത് വിലകുറഞ്ഞ ലോഹങ്ങൾ കൂട്ടിച്ചേർക്കുന്നത്കൊണ്ട്.
d. ചെമ്പുപാത്രങ്ങൾ പുളിയും ചാരവുമുപയോഗിച്ച് കഴുകുന്നത്കൊണ്ട്.

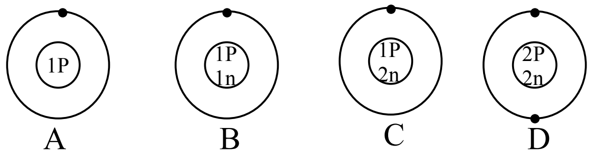
26. താഴെ കൊടുത്തിരിക്കുന്ന ഏത് സന്ദർഭത്തിലാണ് ഒരാറ്റം നെഗറ്റീവ് അയോണായി മാറുന്നത്?

a. ഇലക്ട്രോൺ ലഭിക്കുമ്പോൾ
b. ഇലക്ട്രോൺ നഷ്ടപ്പെടുമ്പോൾ
c. പ്രോട്ടോൺ നഷ്ടപ്പെടുമ്പോൾ
d. പ്രോട്ടോൺ ലഭിക്കുമ്പോൾ

27. ഓരോ ഷെല്ലിലും ഉൾക്കൊള്ളാൻ കഴിയുന്ന പരമാവധി ഇലക്ട്രോണുകളുടെ എണ്ണം കണ്ടുപിടിക്കുന്നതിനുള്ള സൂത്രവാക്യം ഏത്?

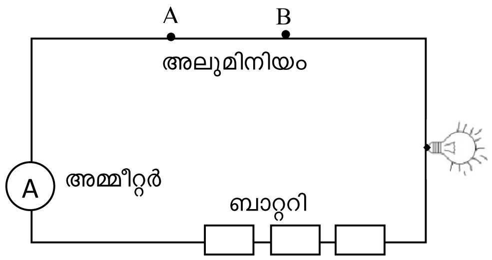
a. $2n^1$
b. $2n^2$
c. $2n^3$
d. $2n$

28. ഹൈഡ്രജൻ പ്രകൃതിയിൽ കണ്ടുവരുന്ന വ്യത്യസ്ത രൂപങ്ങൾ ചിത്രീകരിച്ചിരിക്കുന്നു. ഹൈഡ്രജന്റെ ഈ സവിശേഷത ഏത് പേരിലറിയപ്പെടുന്നു?



a. ഐസോടോപ്പ്
b. ഐസോടോൺ
c. ഐസോമെർ
d. ഐസോബാർ

29.



ചാലകം AB ആയി ഇരുമ്പ് ഉപയോഗിച്ചാൽ ബൾബിന്റെ പ്രകാശ തീവ്രതയിൽ ഉണ്ടാകുന്ന വ്യത്യാസം എന്ത്?

a. പ്രകാശതീവ്രത കൂടുന്നു
b. പ്രകാശതീവ്രത കുറയുന്നു
c. ഒരു മാറ്റവുമില്ല
d. ബൾബ് പ്രകാശിക്കുന്നില്ല

30. താഴെ കൊടുത്തിരിക്കുന്ന രാസപ്രവർത്തനം താപമോചകപ്രവർത്തനമാണെന്ന് സൂചിപ്പി ക്കുന്ന പ്രസ്താവന എത്?

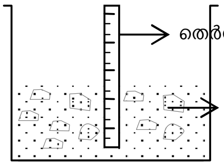
$2H_2(g) + O_2\,(g) \rightarrow 2H_2O\ (l) + 571.6\ KJ$

a. ഊർജ്ജം പുറന്തള്ളപ്പെടുന്നു
b. സംയുക്തം രൂപപ്പെടുന്നു
c. അഭികാരകങ്ങൾ വാതകാവസ്ഥയിലാണ്
d. ഉല്പന്നങ്ങളേക്കാൾ കൂടുതൽ അഭികാരകങ്ങൾ ഉണ്ട്

31. സാധാരണ ഊഷ്മാവിലുള്ള ജലം ബീക്കറിലെടുത്ത് ഭാരം കുറഞ്ഞ നാണയം ജലോപരിതലത്തിൽ വെച്ചാൽ പൊങ്ങികിടക്കുന്നു. എന്നാൽ സോപ്പ് കലക്കിയ ജല മാണെങ്കിൽ നാണയം താഴ്ന്ന് പോകുന്നു. ഇതിന് കാരണമായ പ്രതിഭാസം ഏത്?

a. കേശികത്വം
b. പ്രതലബലം
c. വിസ്കോസിറ്റി
d. അഡിഷൻ

<u>ഒരു ബീക്കറിൽ ഐസ് കട്ടകളെടുത്ത് അതിൽ ഒരു തെർമോമീറ്റർ സാധാരണ ഊഷ്മാവിൽ വച്ചിരിക്കുന്ന ചിത്രം കാണിച്ചിരിക്കുന്നു.</u>



32. അവസ്ഥാമാറ്റം നടക്കുമ്പോൾ തെർമോമീറ്ററിലെ താപനിലയിൽ ഉണ്ടാകുന്ന മാറ്റം എന്ത്?

    a. കുറയുന്നു
    b. കൂടുന്നു
    c. താപനില സ്ഥിരമായി നിൽക്കുന്നു
    d. ആദ്യം കുറയുന്നു പിന്നീട് കൂടുന്നു.

33. ഒരു ഖരം ദ്രാവകാവസ്ഥ പ്രാപിക്കുന്ന സ്ഥിരതാപനില ഏത് പേരിലാണ് അറിയപ്പെടുന്നത്?

    a. തിളനില
    b. ഖരനില
    c. ദ്രവനില
    d. താപനില

Appendix-E5

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY
(Final)

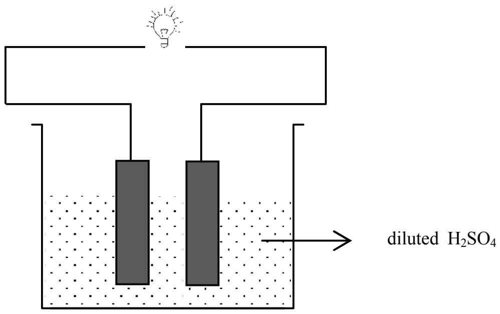
Dr. A. Hameed — Assistant Professor

Meharunnisa Karadan — Research Scholar

Instructions: This test is to measure the process skills in chemistry. For each questions four options a, b, c, d are given. After reading each questions carefully, identify the correct answer and mark on the appropriate box in the answer sheet provided. Answer the questions in less than one minute. Don't write or draw anything on the question paper.

1. What is the reason for using filter paper for separating water from the mixtures of water and mud, water and choak
   a. Difference in size of the particles
   b. Property of evaporation
   c. Colour of particles
   d. Magnetic property

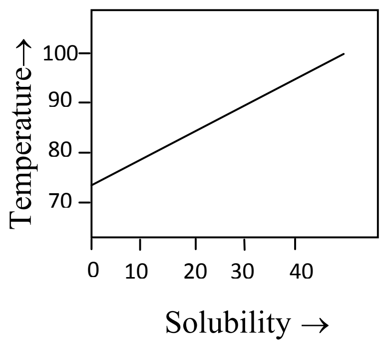
2.



From the above picture, what is the energy change taken place while glowing a bulb?
   a. Heat energy$\rightarrow$ Electrical energy
   b. Light energy$\rightarrow$ Electrical energy
   c. Chemical energy $\rightarrow$ Light energy
   d. Magnetic energy $\rightarrow$ Electrical energy

3. Analyse the ratio of atoms in the molecular structure of water
   a. 2 elements and 3 atoms
   b. 2 elements and 2 atoms
   c. 3 elements and 2 atoms
   d. 3 elements and 3 atoms

4. Besides being valuable, gold is special because it can be hammered in to a very thin foil. This property of metal is generally called as
   a. Malliability
   b. Ductility
   c. Conductivity
   d. Soronity
5. Atoms H^1, He^2, Li^3 having atomic numbers 1, 2, 3 respectively. Which picture represents ascending order in atomic number of the above atoms?
   a. 
   b. 
   c. 
   d. None of these
6. If you scratch two pieces of aluminum and iron in a rough place, you can see bright glows on it. This property of metals is called
   a. Metallic luster
   b. Malliability
   c. Metallic conductivity
   d. Ductility
7. From the picture below, what is the relationship between solubility and temperature?



   a. Solubility increases when temperature decrease
   b. Solubility increase when temperature increases
   c. Solubility remains constant
   d. None of these
8. Metals which contain iron reacts with other substances in the surroundings and produces new substances. This process can be operationally defined as
   a. Corrosion
   b. Hydration
   c. Polymerization
   d. Emulsion

Suppose two beakers A and B contains solutions of sugar. When we add little sugar in to both of these breakers, it will soluble in beaker 'A' but not soluble in beaker 'B'.

9. In the above solutions which is solute?
   a. Water
   b. Sugar
   c. Sugar solution
   d. None of these

10. What we call the solution of the beaker 'B'
    a. Saturated solution
    b. Solid solution
    c. Super saturated solution
    d. Emulsion

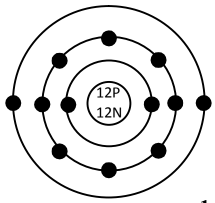
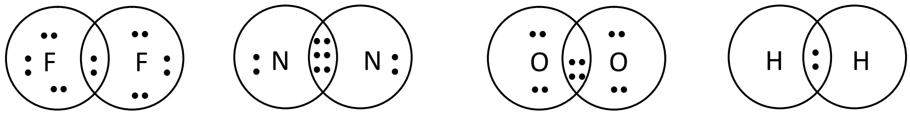
11. 

    Image represents the Bohr model of the element magnesium. From this find out the valency of magnesium?
    a. 2
    b. 1
    c. 3
    d. 4

12. Outermost shell of lithium contains one electron. For getting stability what lithium atom do?
    a. Accepts on electron
    b. Withdraws one electron
    c. Withdraws three electrons
    d. Elements itself has stability

13. Which of the gas cause ozone depletion?
    a. O_2
    b. CFC
    c. N_2
    d. CO_2

14. Suppose, a jar contains flowers with different colours. Which gas may helps to remove the colour of flowers?
    a. Chlorine
    b. Flourine
    c. Bromine
    d. Oxygen

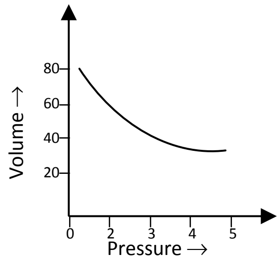


15. What is the name of chemical bond that seen in the above compounds?
    a. Covalent bond
    b. Metallic bond
    c. Ionic bond
    d. Compound bond
16. Which element has double bond?
    a. Fluorine
    b. Nitrogen
    c. Oxygen
    d. Hydrogen
17. Which element contain triple bond?
    a. Flourine
    b. Nitrogen
    c. Oxygen
    d. Hydrogen
18. When zinc and hydrogen reacted together produce a gas, which when filled in a Balloon it flies up. Do you guess what is the gas inside the Balloon?
    a. Oxygen
    b. Hydrogen
    c. Nitrogen
    d. Argon
19. Boiling points of four liquids are given. From the table given below identify the element which vapourises first?

Liquid	A	B	C	D
Boiling Point	189^0C	183^0C	176^0C	195^0C

    a. Liquid A
    b. Liquid B
    c. Liquid C
    d. Liquid D

20. Graphical representation of a gas with a specific weight with its volume at different pressure are given. Find out the relation between pressure and volume?



a. Pressure increase when volume decreases
b. Pressure increase when volume increases
c. No relation between volume and pressure
d. No relation between volume and temperature

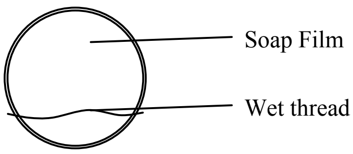
21.

E		X		G
			J	
		L		

In the picture E, X, G, J & L indicates positions of five elements. If atomic number of 'X' is 'Z', identify the element having atomic number of 'Z+2'.

a. E
b. G
c. J
d. L

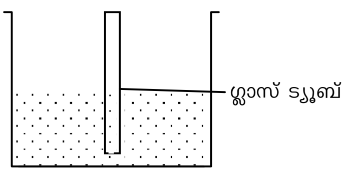
22.



A soap film is made in metal. A wet thread is tied in that like shown in the picture. What will happens if destroying the soap film in the lesser area part?

a. Soap film completely vanishes
b. The soap film in the larger area remains and it shrinks
c. The thread cuts off
d. No soap film is made on the metal circle

23.



If the glass tube immersed in the liquid is thinner than seen in picture, what change would happen, to the capillary rise?

a. Increases
b. Decreases
c. No change
d. Water doesn't in to the tube

24. A white cloth, after applying silver nitrate, puts under sunlight. After sometime, the area which silver nitrate had applied appears to be black in colour. Which energy is responsible for this?

a. Light
b. Heat
c. Chemical energy
d. Electric energy

25. Geethu noticed that copper utensils in her home gradually turn black in colour where as the steel utensils remain as such. The reason discovered by Geethu for this change is

a. Reacts with oxygen and produces copper oxide
b. Reacts with sulphur in the air and produces sulphates
c. Adding cheap metals to the copper vessels during manufacturing
d. Cleaning copper vessels using ashes tamerind

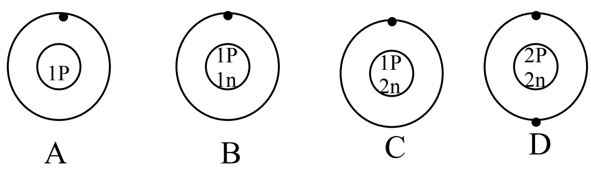
26. On what circumstances an atom became a negative ion?

a. Gain electron
b. Loss electron
c. Loss proton
d. Gain proton

27. What is the equation for calculating maximum number of electrons occupy in a particular shell?

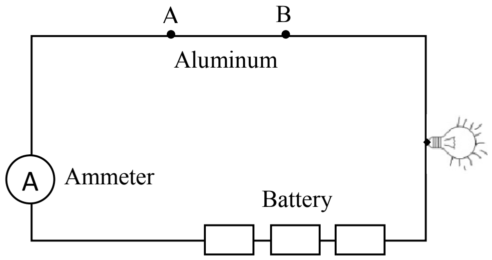
a. $2n^1$
b. $2n^2$
c. $2n^3$
d. $2n$

28. Different forms of hydrogen in nature is picturised below. What is the name of this property?



a. Isotope
b. Isotone
c. Isoner
d. Isobar

29.



If iron is used as conductor 'AB' what difference occur in the intensity of lighting of bulb?

a. Intensity of light increases
b. Intensity of light decreases
c. No change
d. Bulb is not glowing

30. Which of the statements indicates that following reaction is an exothermic reaction?

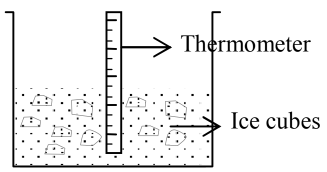
$2H_2(g) + O_2(g) \rightarrow 2H_2O(l) + 571.6$ KJ

a. Energy released
b. Compound is formed
c. Reactants are in gaseous state
d. Reactants are more than products

31. When a low weight coin is placed on the surface of water at normal temperature in a beaker, it floats, but when it is placed above the soap water it drawns. What is the reason for this phenomenon?

a. Capillarity
b. Surface tension
c. Viscosity
d. Adhesion

<u>Picture shows some ice cubes are taken a beaker and put a thermo meter in it.</u>



32. During change in state, the temperature of thermometer?

    a. Decrease
    b. Increase
    c. Temperature become constant
    d. First decreases then increases

33. Name the temperature at which a solid becomes a liquid?

    a. Boiling point
    b. Freezing point
    c. Melting point
    d. Temperature

Appendix- E6

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY

Response Sheet

വിദ്യാർത്ഥിയുടെ പേര്:...

വിദ്യാലയത്തിന്റെ പേര്:.. ക്ലാസ്:............

ആൺ/പെൺ:.. ഗവൺമെന്റ്/എയ്ഡഡ്/അൺ-എയ്ഡഡ്

Sl. No	a	b	c	d
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				

Sl. No	a	b	c	d
18.				
19.				
20.				
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				
31.				
32.				
33.				

Appendix- E7

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INTEGRATED PROCESS SKILLS IN CHEMISTRY
(Final)

Scoring Key

Ques. No.	Answer	Ques. No.	Answer
1	a	18	b
2	c	19	d
3	a	20	a
4	a	21	b
5	b	22	b
6	a	23	a
7	b	24	a
8	a	25	a
9	b	26	a
10	c	27	b
11	b	28	a
12	b	29	a
13	b	30	a
14	a	31	b
15	a	32	b
16	c	33	c
17	b		