MINOR RESEARCH PROJECT

EFFECT OF MULTIPLE INTELLIGENCE INSTRUCTIONAL STRATEGIES ON ATTITUDE TOWARDS SCIENCE LEARNING AND ACADEMIC ACHIEVEMENT IN SCIENCE AMONG STANDARD IX STUDENTS

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DECLARATION

We hereby declare that the project entitled ***'Effect of Multiple Intelligence Instructional Strategies on Attitude towards Science Learning and Academic Achievement in Science among Standard IX Students'*** submitted to Internal Quality Assurance Cell is our original work and the project has not formed the basis for the award of any degree, diploma, associateship, fellowship or similar other titles. It has not been submitted to any other University or Institution for the award of any degree or diploma.

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CERTIFICATE

Certified that the project entitled ***'Effect of Multiple Intelligence Instructional Strategies on Attitude towards Science Learning and Academic Achievement in Science among Standard IX Students'*** is a record of project work done by Dr. S. Chamundeswari, Principal Investigator, Dr. Deepa Edwin, Co-investigator, Dr. V.J. Uma Co-investigator, during the academic year 2018-2019 and that the project has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or similar other titles and that is an independent work done by the investigators.

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EFFECT OF MULTIPLE INTELLIGENCE INSTRUCTIONAL STRATEGIES ON ATTITUDE TOWARDS SCIENCE LEARNING AND ACADEMIC ACHIEVEMENT IN SCIENCE AMONG STANDARD IX STUDENTS

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"It's not how smart you are that matters, what really counts is how you are smart."

~ Howard Gardner

1. INTRODUCTION

From birth, all human beings have different abilities and every child has unique properties. Until 1940s, children are meritorious because of their inner potentials, creativity, power to learn, ability to learn languages, potential to use brain (Akboy, 2004; Akboy and Ikiz, 2007). How children perceive themselves and their educational experiences, establish their self concept and also prior to the development of self-efficiency. A successful transition from childhood to adolescence partially depends upon the academic preparation and the motivation of student as well as the school's effectiveness in helping the student acquire life survival skills. Whether the schools use testing, orientation and advising programs to help them take full advantage of the environmental and personal resources necessary for their success, is a question. Since every individual has unique set of experiences, a variety of responses to any given stimulus is possible. Learning is essentially an active process that the attention, curiosity and interest of the perceiver often increase. Therefore, provision for individual differences in learning is crucial (Fraenkel, 1994). The special academic and personal characteristics of students and how these characteristics affect their success have to be taken into consideration.

Bruner (1983) investigated the reason for children finding school learning very difficult. He discovered that it was because children experienced it as very separate from their real lives. His theory of learning is essentially "constructivist", a model of learning in which the child is seen as an "active agent" in his or her own learning, retaining, selecting and transforming information to construct knowledge which is shaped by his or her unique way of seeing and interpreting the world (Brooks and Brooks, 1999; Yurdakul, 2004; Bas, 2010a). Bruner (1983) also thought that the child's learning is a process, not merely a product, which can be accelerated or enhanced by social and group processes.

The work of Vygotsky (1978) is very important since he emphasised the role of "social atmosphere/interaction". He sees children as constructing their understating from the social interaction of their learning contexts with all its possibilities and limitations. In this regard, as Anning (1991) suggests that children are unique in what they bring to the learning experience but tend to draw on the same kinds of learning strategy. This means that we must think of learners as having individual differences so that teachers need to pay attention to the organisation of their classrooms. They must also consider their students' "learning styles" (Dunn, 2000) and different "intelligence profiles" (Gardner, 1993, 1999). As teachers must consider their students' *intelligence profiles and learning styles* and they must also consider them as having individuals, they must use the modern language learning methods and approaches in their classroom in order to create an atmosphere which pays attention to learners with different learning preferences (Bas, 2009b). In the learning environment, it is essential that the learning atmosphere must be "student-centred" so that students in this atmosphere must do the activities by themselves or in other words they must adopt the responsibility of their own learning (Abbott and Ryan, 1999; Bas, 2008, 2009a; Brooks and Brooks, 1999; Yurdakul, 2004).

2. NEED FOR THE CURRENT RESEARCH

The technological advances that have been made have in many ways have made our lives easier but some of them have taken a terrible toll by polluting our cities, our waters, the air that we breathe and the food that we grow. Making our children more responsible will make the environment more habitable and will lessen the rapid decline and turn it around so that we change the impetus to own of preserving rather than destroying. The answer to our future is in the hands of our children, so Science learning is one of the most important things that we can do.

Today's children have the opportunity to learn Science in different ways than generations before them, as the world is undergoing dramatic changes that affects how they will live and survive in the future. At the turn of the present century young people can learn most readily about things that are tangible and directly accessible to their senses—visual, auditory, tactile, and kinaesthetic. With experience, they grow in their ability to understand abstract concepts, manipulate symbols, reason logically, and generalize. These skills develop slowly, however, and the dependence of most people on concrete examples of new ideas persists throughout life. Concrete experiences are most effective in learning when they occur in the context of some relevant conceptual structure.

The difficulties many students have in grasping abstractions are often masked by their ability to remember and recite technical terms that they do not understand. As a result, teachers—from kindergarten through college—sometimes overestimate the ability of their students to handle abstractions, and they take the students' use of the right words as evidence of understanding. Especially for a subject like Science, much intelligence is required. The Multiple Intelligences Theory in a nutshell, is a pluralized way of understanding the intellect. Recent advances in cognitive Science, developmental psychology and neuro Science suggest that each person's level of intelligence, as it has been traditionally considered, is actually made up of autonomous faculties that can work individually or in concert with other faculties.

While everyone might possess eight intelligences, they are not equally developed in any one individual. Some teachers feel that they need to create activities that draw on all eight, not only to facilitate knowledge acquisition amongst diverse students, but also to help them realize their full potential with all eight. One way of doing so is to think about the activities that are frequently used in the classroom and to categorize them according to intelligence type (Larsen-Freeman, 2000).

If we accept that different intelligences predominate in different people, it suggests that the same learning task may not be appropriate for all our students. While people with a strong logical /mathematical intelligence might respond well to a complex grammar explanation, a different student might need to comfort of diagrams and physical demonstration because their strengths is in the visual /spatial area. Other students who have a strong interpersonal intelligence may require a more interactive climate if their learning is to be effective (Harmer, 2001). Intelligence has traditionally been defined in terms of intelligence quotient (IQ), which measures a narrow range of verbal/linguistic and logical/mathematical abilities (Christison, 1996). Gardner (1993) argues that humans possess a number of distinct intelligences that manifest themselves in different skills and abilities. All human beings apply these intelligences to solve problems, invent processes, and create things. Intelligence, according to Multiple Intelligences Theory, is being able to apply one or more of the intelligences in ways that are valued by a community or culture. The Theory of Multiple Intelligences offers eight ways of teaching and learning styles. In this regard, armed with the knowledge and application of the multiple intelligences, teachers can ensure they provide enough variety in the activities they use so that as much of their pupils' learning potential can be tapped as possible (Berman, 1998; Bas, 2008, 2010b).

The younger the learners the more physical activity they tend to need and the more they need to make use of all their senses (Brewster, Ellis and Girard, 2003). According to Berman (1998), if children can draw or visualize an image, hum it or move through it first, they may be able to more easily talk or write about it. On the basis of the Theory of Multiple Intelligences in this regard, children can also draw a picture while listening to a description, act out a nursery rhyme, follow instructions or make a shape or simple model while they listen to a description of it. This draws on learning by the ear and eye and is good for those with bodily-kinesthetic intelligence.

There are research studies that explain the advantages of using multiple intelligences instruction strategy in educational settings especially in Mathematics and Science teaching (Korkmaz, 2001; Ozdemir, 2002; Yıldırım, Tarim and Iflazoglu, 2006). The dearth of studies in the Indian context has made it very much fundamental for the present investigation to be carried on.

3. THEORETICAL BACKGROUND OF THE PRESENT STUDY

Several educationalists, researchers and school administrators view the social constructivist learning theory engendered by Russian psychologist, Vygotsky (1896-1934), as central to instructional enhancement, classroom change and redevelopment (Rueda, Goldenberg, and Gallimore, 1992; Kearsley, 1996; Blanton, 1998; Tharp and Gallimore, 1988; Riddle and Dabbagh, 1999; Flem, Moen, and Gudmundsdottir, 2000; Goldfarb, 2000; Shambaugh and Magliaro, 2001).

Sociocultural theory, drawing on the work of Vygotsky (1962), and later Wertsch (1991), has significant implications for teaching, schooling and education (Tharp and Gallimore, 1988). This theory is based on the premise that the individual learner must be studied within a particular social and cultural context (Tharp and Gallimore, 1988; Blanton, 1998; Patsula, 1999; Flem et al., 2000; MacGillivray and Rueda, 2001). Such situatedness is necessary for the development of higher order functions, and such functions can only be acquired and cultivated following social interaction (Rueda et al., 1992; Blanton, 1998; Riddle and Dabbagh, 1999; Shambaugh and Magliaro, 2001). Social interaction is therefore fundamental to the development of cognition (Kearsley, 1996, 2005; Patsula, 1999; Riddle and Dabbagh, 1999; MacGillivray and Rueda, 2001; Scherba de Valenzuela, 2002). Furthermore, as a departure from other theories regarding cognition, Vygotsky's theory views education as an ongoing process, not a product (Riddle and Dabbagh, 1999).

4. CONCEPTUAL FRAME WORK OF THE STUDY

Vygotsky's General Theory of Cognitive Development, was used as a framework for this investigation, as it has implications for teaching and learning in contemporary times (Patsula, 1999; Flem and others, 2000; MacGillivray and Rueda, 2001; Shambaugh and Magliaro, 2001; Kearsley, 2005). The areas of social interaction, engagement between teacher and student, physical space and arrangement, meaningful instruction, scaffolding, student ability and powerful content all become elements to consider within the context of contemporary education. With its emphasis on social interaction, Vygotsky's theory sees the student-teacher relationship as collaborative, with the learning experience becoming reciprocal (Riddle and Dabbagh, 1999; Flem and others, 2000; Shambaugh and Magliaro, 2001). The instructional environment, including the physical arrangement of furniture would be so structured to promote interaction (Riddle and Dabbagh, 1999). Furthermore, the teacher would so design the lesson that instruction will extend the student to just above the student's current developmental level, building on that which the student already knows, but encouraging the student to move ahead into areas that pose greater challenge (Riddle and Dabbagh, 1999; MacGillivray and Rueda, 2001). In this regard, scaffolding would be an appropriate strategy to access the zone of proximal behaviour (Riddle and Dabbagh, 1999). The teacher would again engage student interest and modify tasks to suit ability levels (Riddle and Dabbagh, 1999). Lesson content will also be meaningful, compelling learner interest and providing a basis for the use of mediating tools like language (Patsula, 1999; MacGillivray and Rueda, 2001). In keeping with this grounded theory, differentiated instruction proposes a viable alternative to traditional teaching strategies. It offers students the options of moving on to more complex material once they have mastered certain key skills, it offers the teacher a more dynamic, facilitating role, and it creates a purposeful learning environment that maximizes opportunities for meaningful learning.

4.1 Intelligence

The concept of intelligence, a very old one, has been employed in the most varied ways over the centuries. Intelligence comes from the Latin verb "intellegere", which means "to understand". By this rationale, intelligence (as understanding) is arguably different from being "smart" (able to adapt to one's environment), or being "clever" (able to creatively adapt).

According to Alfred Binet (1905), intelligence is defined as judgment, otherwise called good sense, practical sense, initiative, the faculty of adapting one's self to circumstances. Cyril Burt (1935) defined intelligence as the innate general cognitive ability.

According to David Wechsler (1940) it is the aggregate or global capacity of the individual to act purposefully, to think rationally, and to deal effectively with his environment. According to Howard Gardner (1993a) intelligence is a human intellectual competence must entail a set of skills of problem solving—enabling the individual to resolve genuine problems or difficulties that he or she encounters and, when appropriate, to create an effective product—and must also entail the potential for finding or creating problems—and thereby laying the groundwork for the acquisition of new knowledge.

During the past century, there has been considerable movement on the "intelligence front," and this trend shows no sign of abating. Until this century, the word "intelligence" has been used primarily by ordinary individuals in an effort to describe their own mental powers as well as those of other persons. Consistent with ordinary language usage, "intelligence" has been deployed in anything but a precise manner. Forgetting about homonyms which denote the gathering of information, individuals living in the West were called "intelligent" if they were quick or eloquent or scientifically astute or wise. In other cultures, the individual who was obedient, or well behaved, or quiet, or equipped with magical powers, may well have been referred to by terms which have been translated as "intelligent." By the 1920's and 1930's, intelligence tests (and their product, an individual's IQ) had become deeply ensconced in many other parts of the world.

Intelligence is a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings—"catching on", "making sense" of things, or "figuring out" what to do (Gottfredson, 1997).

Individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought. Although these individual differences can be substantial, they are never entirely consistent: a given person's intellectual performance will vary on different occasions, in different domains, as judged by different criteria. Concepts of "intelligence" are attempts to clarify and organize this complex set of phenomena. Although considerable clarity has been achieved in some areas, no such conceptualization has yet answered all the important questions and none commands universal assent. Indeed, when two dozen prominent theorists were recently asked to define intelligence, they gave two dozen somewhat different definitions (Gardner, 1993a; Neisser and others, 1998).

Intelligence is of considerable interest to academics and lay people alike (Sternberg, 1990; Mackintosh, 1998). Over the past decade there have been a number of studies concerned with self-estimates of intelligence. Although various other studies predated it (Hogan, 1978), it was Beloff's (1992) study on sex differences in estimated IQ that has provoked most papers since (Byrd and Stacey, 1993; Furnham and Rawles, 1995; Bennett, 1996, 1997, 2000; Furnham and Baguma, 1999; Furnham, Clark, and Bailey, 1999; Furnham, Fong, and Martin, 1999; Furhnam, 2000; Furnham and Fong, 2000; Petrides and Furnham, 2000; Furnham, Hosoe, and Tang, 2002; Neto, Ruiz, and Furnham, 2008). In a sample of 767 Scottish students Beloff (1992) found that women underestimate their intelligence whereas men overestimate their intelligence. She proposed that in females' upbringing there is an emphasis on humility and they receive "modesty training", resulting in poor intellectual self-image relative to males. This area of research is seen as important because it has been demonstrated that beliefs about intelligence have systematic motivational and behavioural consequences (Dweck, 2000).

While intelligence was initially perceived as a unitary (if overarching) concept, which could be captured by a single number, a debate soon arose about whether the concept could legitimately be broken into components. Researchers like, Thurstone (1947) and Guilford (1967) argued that intelligence was better conceived of as a set of possibly independent factors. In recent years, buoyed by findings from fields as disparate as artificial intelligence, developmental psychology, and neurology, a number of investigators have put forth the view that the mind consists of several independent modules or "intelligences."

Theories of intelligence can be divided into those based on a unilinear construct of general intelligence and those based on multiple intelligences. Francis Galton, influenced by Charles Darwin, was first to advance a Theory of General Intelligence. For Galton, intelligence was a real faculty with a biological basis that could be studied by measuring reaction times to certain cognitive tasks (Action, 2008).

Alfred Binet and the French school of intelligence believed that intelligence quotient (IQ) was an average of numerous dissimilar abilities, rather than a real thing with specific identifiable properties. The Stanford-Binet intelligence test has been used by both theorists of general intelligence and multiple intelligences. It is, however, the basis for the development of various theories of multiple intelligences (Action, 2008).

4.2 Multiple Intelligence

Intelligence is the ability to apply knowledge in order to perform better in an environment. Intelligence has traditionally been defined in terms of intelligence quotient (IQ), which measures a narrow range of verbal/linguistic and logical/mathematical abilities (Christison, 1996).

Gardner (1983) claims that intelligence is comprised of multiple modules or types, which are largely independent and functionally separate from each other. According to Gardner (1993) humans possess a number of distinct intelligences that manifest themselves in different skills and abilities. While everyone might possess eight intelligences, they are not equally developed in any one individual. All human beings apply these intelligences to solve problems, invent processes, and create things. In his Theory of Multiple Intelligences, Gardner (1999) argued that certain intelligences were valued in the schools while others were not. Some teachers feel that they need to create activities that draw on all eight, not only to facilitate language acquisition amongst diverse students, but also to help them realise their full potential with all eight. One way of doing so is to think about the activities that are frequently used in the classroom and to categorise them according to intelligence type (Larsen-Freeman, 2000).

If we accept that different intelligences predominate in different people, it suggests that the same learning task may not be appropriate for all our students. While people with a strong logical / mathematical intelligence might respond well to a complex grammar explanation, a different student might need to comfort of diagrams and physical demonstration because their strengths is in the visual / spatial area. Other students who have a strong interpersonal intelligence may require a more interactive climate if their learning is to be effective (Harmer, 2001).

According to Gardner (1999), since all human beings possess all different intelligences in varying degrees and each individual manifests varying levels of these different intelligences, each person has a unique "cognitive profile"; that is, (i) all human possess all different intelligences in varying amounts; (ii) Each individual has a different composition; (iii) Different intelligences are located in different areas of the brain and can either work independently or together; (iv) By applying Multiple Intelligences we can improve education; and (v) These intelligences may define human species.

4.2.1 Basis for Intelligence

Gardner argues that there is both a biological and cultural basis for the multiple intelligences. Neurobiological research indicates that learning is an outcome of the modifications in the synaptic connections between cells. Primary elements of different types of learning are found in particular areas of the brain where corresponding transformations have occurred. Thus, various types of learning result in synaptic connections in different areas of the brain. For example, injury to the Broca's area of the brain will result in the loss of one's ability to verbally communicate using proper syntax. Nevertheless, this injury will not remove the patient's understanding of correct grammar and word usage.

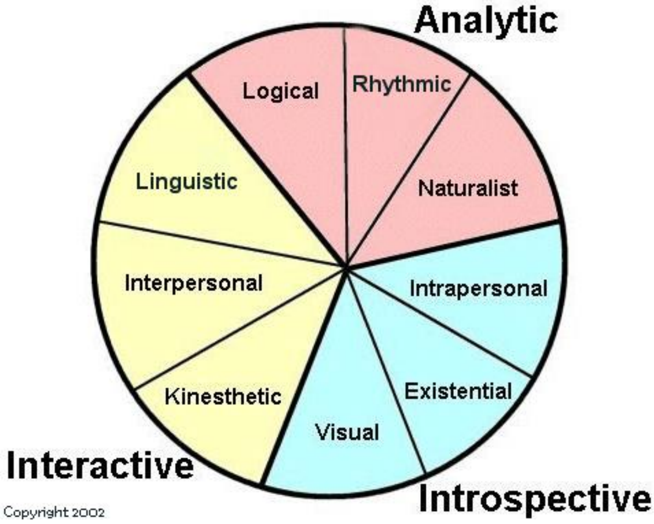
In addition to biology, Gardner (1983) argues that culture also plays a large role in the development of the intelligences. All societies value different types of intelligences. The cultural value placed upon the ability to perform certain tasks provides the motivation to become skilled in those areas. Thus, while particular intelligences might be highly evolved in many people of one culture, those same intelligences might not be as developed in the individuals of another.

4.2.2 Multiple Intelligence Domain

Multiple intelligences consist of three domains: the analytical, introspective and interactive domains. These three domains serve as an organizer for understanding the fluid relationship of the intelligences and how the intelligences work with one another. Teachers can plan lessons and units which effectively address all of the intelligences in the classroom (McKenzie, 2002). The following figures (Figure-1 to 1c) presents the three domains.

Figure-1

Multiple Intelligences Domains

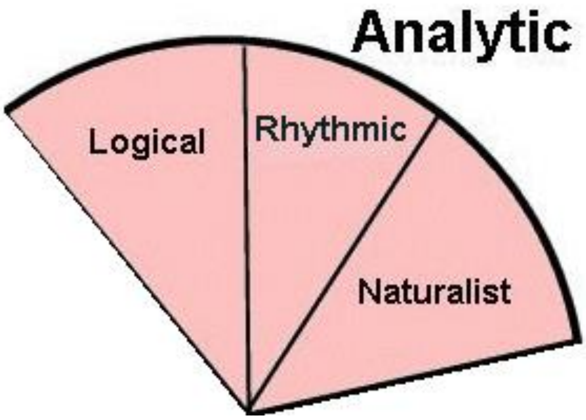


Each domain and its sub-branches in details are presented hereunder.

The Analytical Domain

Figure 1a

The Analytic Domain

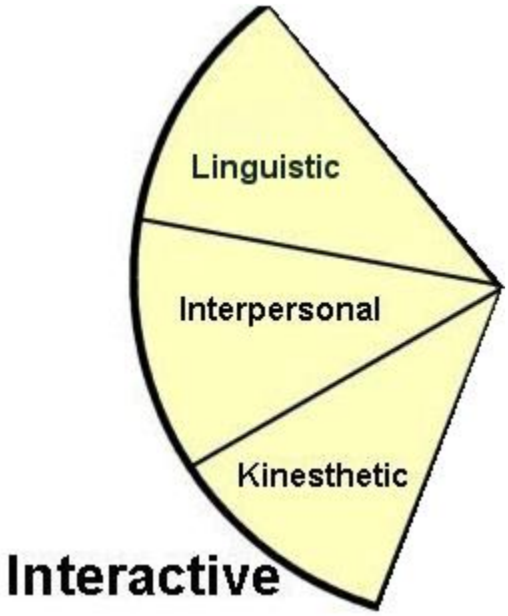


According to McKenzie (2002), the analytic domain consists of the logical, musical and naturalist intelligences. These are the intelligences that promote analysis of knowledge that is presented to the learner. These three intelligences are considered analytic because they promote the processes of analyzing and incorporating data into existing schema, even though they may have other components. The analytical intelligences are by their nature heuristic processes.

The Interactive Domain

Figure 1b

The Interactive Domain

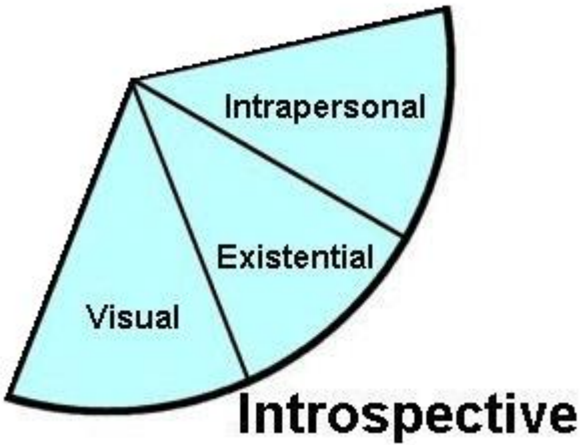


McKenzie (2002) indicates that the interactive domain consists of the linguistic, interpersonal and kinesthetic intelligences. These are the intelligences that learners typically employ to express themselves and explore their environment. These three intelligences are regarded as interactive because they typically invite and encourage interaction to achieve understanding. Even if a student completes a task individually, s/he must consider others through the way s/he writes, creates, constructs and makes conclusion. The interactive intelligences are by their nature social processes (McKenzie, 2002).

The Introspective Domain

Figure 1c

The Introspective Domain



The introspective domain consists of existential, intrapersonal, and visual intelligences. These are the intelligences that have a distinctly affective component to them. These intelligences are characterized as introspective because they require a looking inward by the learner, an emotive connection to their own experiences and beliefs in order to make sense of new learning. The introspective intelligences are by their nature affective processes (McKenzie, 2002).

4.2.3 Categories of Intelligence

Intelligence, according to Multiple Intelligences Theory, is being able to apply one or more of the intelligences in ways that are valued by a community or culture. Gardner (1983) suggested that all individuals have personal intelligence profiles that consist of combinations of seven different intelligence types. In 1999, Gardner added an eighth intelligence type to the list; that is, natural intelligence. Moreover, two years later a ninth type, namely existential intelligence, was added to the list (Gardner, 1999).

Figure-2

Types of Multiple Intelligence

(Gardner, 1999)

(i) Linguistic Intelligence

Gardner has described Linguistic intelligence as sensitivity to spoken and written language and the ability to use language to accomplish goals, as well as the ability to learn new languages. According to Gardner (1993), lawyers, public speakers, writers, and poets all possess high levels of linguistic intelligence.

The linguistic intelligence domain, as described by Gardner, seems to encompass a wide variety of more specific abilities. Thurstone (1938), for example, differentiated between verbal comprehension and word fluency, which represented two of his seven primary mental abilities, whereas Gardner would include both under the domain of linguistic intelligence.

Verbal comprehension involves the ability to understand the meanings both of individual words and of passages of written or spoken texts. Word fluency, in contrast, involves the ability to generate rapidly many examples of words that meet some specification (e.g., words beginning with a given letter, words rhyming with a target word, words naming objects that have some property, etc.).

(ii) Logical/ Mathematical Intelligence

Gardner described logical/mathematical intelligence as the ability to study problems, to carry out mathematical operations logically and analytically, and to conduct scientific investigations. Gardner identified mathematicians, logicians, and scientists as persons who would possess high levels of this hypothesized intelligence.

Reasoning, the domain whose content is subsumed within the definition of Gardner's logical/mathematical intelligence, was identified as one of the primary mental abilities recovered by Thurstone (1938). According to Carroll (1993), reasoning subsumes six firststratum factors: general reasoning, verbal reasoning, induction, quantitative reasoning, syllogistic reasoning, and classification ability. Quantitative reasoning, which combines numerical content with logical thinking, would seem to be a prototypical exemplar of Gardner's logical/mathematical intelligence domain. Carroll (1993) found that the firststratum factor of quantitative reasoning was highly *g*-loaded, as were other reasoning abilities, such as induction.

The logical/ mathematical domain of Gardner's framework would also subsume numerical facility, which is measured with tasks requiring participants to quickly perform simple arithmetic computations, such as addition, subtraction and multiplication. This numerical skill emerged as one of the primary mental abilities in Thurstone's (1938) research, defining a different factor from that which subsumed reasoning tasks, although quantitative reasoning also shows some association with this factor. In Carroll's (1993) review, a first stratum factor of numerical facility was somewhat less *g*-loaded than was that of quantitative reasoning.

(iii) Spatial/ Visual Intelligence

Gardner defined spatial intelligence as the ability to recognize both large and small visual patterns. He suggested that navigators and pilots would possess high levels of spatial intelligence, as would sculptors, surgeons, chess players, and architects.

Previous research in the domain of spatial abilities suggests that spatial visualization and spatial scanning are two important and distinct aspects of that domain (e.g., Ekstrom, French, Harman and Derman, 1976). Spatial visualization refers to the ability to imagine the movement of an object and is typically measured with mental rotation tasks. Carroll (1993) noted that visualization tasks generally form a first-stratum factor, and one that tends to be highly *g*-loaded. Spatial scanning is the ability to scan a field quickly, to follow paths visually, and to reject false leads (Ekstrom and others., 1976). Carroll (1993) tentatively identified this capacity as a first-order factor, but stated that further research was necessary before it could be considered independent and interpreted accordingly. Tasks assessing spatial visualization and spatial scanning tend to load on a second-stratum factor of broad visualization ability, which corresponds also to Thurstone's (1938) spatial ability factor.

(iv) Musical Intelligence

Gardner (1999) suggests that musical intelligence is parallel in structure to linguistic intelligence, and that it is reflected in the performance, composition, and appreciation of musical patterns. With regard to the underlying abilities involved in his musical intelligence, Gardner has claimed that the two most central constituent elements of music are rhythm and pitch (or melody), followed in importance by timbre, which Gardner (1983) describes as the characteristic qualities of a tone. The eight music-relevant factors included the following: discrimination of tones and sequences of tones with respect to basic attributes such as pitch, intensity, duration, and rhythm; auditory cognitive relations (judgments of complex relations among tonal patterns); tonal imagery; discrimination and judgment of tonal patterns in musicality; temporal tracking; ability to recognize and maintain mentally an equal-time beat; ability to retain, on a short-term basis, images of tones, tonal patterns, and voices; and absolute pitch ability. Thus, given that rhythm and tone would appear to be core aspects of these narrow factors of musical ability, measures of the abilities to discriminate between rhythms and between tones would be important elements in the assessment of Gardner's musical intelligence.

(v) Bodily-Kinesthetic Intelligence

Gardner (1999) described this intelligence as the potential of using the whole body or parts of the body in problem-solving or the creation of products. Gardner identified not only dancers, actors, and athletes as those who excel in bodily-kinesthetic intelligence, but also craftspeople, surgeons, mechanics, and other technicians. Thus, Gardner does not appear to differentiate between gross motor skills (i.e., involving the whole body or the larger muscle groups) and fine motor skills (i.e., involving smaller muscle groups, especially those controlling the hands and fingers) in describing bodily-kinesthetic intelligence. Gardner has not explained why these abilities would be expected to be strongly associated with each other. Given that the bodily-kinesthetic domain subsumes both gross and fine motor skills, the assessment of this domain would require measurements of both of these intuitively rather distinct areas of ability.

(vi) Interpersonal Intelligence

According to Gardner (1983), an individual who is high in interpersonal intelligence understands the intentions, motivations, needs, and desires of others, and is capable of working effectively with them. Gardner stated that teachers, clinicians, salespeople, politicians, and religious leaders all use interpersonal intelligence.

Gardner's interpersonal intelligence would seem to be related to the construct of emotional intelligence, which can be associated with intelligence or with personality depending on how it is measured. For example, O'Conner and Little (2003) reported that an ability-based measure of emotional intelligence was correlated more strongly with cognitive ability than with personality. A self-report inventory of emotional intelligence, on the other hand, was correlated more strongly with personality than with cognitive ability.

The interpersonal domain would seem to include both an understanding of verbal and nonverbal social cues. The individual with a high level of interpersonal ability would likely possess both an awareness of the social consequences of events and also an understanding of the motivations and intentions underlying people's behavior. Thus, this domain could be assessed by asking an individual to anticipate the development of a social situation, or to infer the state of mind of a person based on his or her words or actions.

(vii) Intrapersonal Intelligence

Gardner (1999) described intrapersonal intelligence as the ability to understand and to have an effective working model of oneself. Intrapersonal intelligence, as conceptualized by Gardner, includes the awareness of one's own desires, fears, and abilities, and also using this information to make sound life decisions.

From Gardner's description, it appears that having a clear concept of oneself is a key component of his intrapersonal domain. In previous research, self-concept clarity was operationalized in an investigation of the nature of self-esteem (Campbell, 1996) in which participants made “me/not me” decisions for a 56-item list of adjectives, within which were 25 pairs of opposite poles of various personality traits. Campbell was then able to examine the inconsistency of participants' self-descriptions by determining to what extent they endorsed opposites to describe themselves. Results indicated that this measure effectively distinguished high self-esteem and low self-esteem groups, which were hypothesized to differ in self-concept clarity. Therefore, assessments of self-concept clarity might serve as an indicator of intrapersonal ability.

Intrapersonal intelligence, as described by Gardner, is also somewhat related to metacognition in general and to the ability to self-monitor in particular. That is, the individuals with high intrapersonal ability should be aware of what they know as well as what they do not know. However, Stankov (2000) reported that his research has found very little correlation between self-monitoring ability, as measured by the difference between a confidence score and the actual percentage of correctly solved items, and intelligence. These findings could be interpreted as support for Gardner's contention that intrapersonal ability is an independent area of intelligence. Thus, measures of the extent to which individuals can accurately judge their relative strengths and weaknesses might serve as an index of intrapersonal ability.

(viii) Naturalistic Intelligence

Gardner (1999) described a naturalist as one who is able to recognize and classify objects. According to Gardner, hunters, farmers, and gardeners would have high levels of naturalistic intelligence, as would artists, poets, and social scientists, who are also adept at pattern-recognition. He stated that a marketing professional who promotes the small differences between competing products is applying naturalistic intelligence, as is the individual who can recognize cars from the sounds of their engines.

As described above, a central element of Gardner's naturalistic intelligence is the capacity to categorize objects according to salient similarities and differences among them. This ability is critically involved in the generation of meaningful taxonomies of both living and non-living objects. Therefore, categorization tasks of this kind would appear to be ideal measures of the naturalistic domain. It is worth noting that these tasks also appear to demand a high level of logical reasoning, which suggests that cognitive demands for this domain might in fact be similar to those for Gardner's logical/mathematical intelligence, despite being applied to the realm of semantically meaningful stimuli rather than to the domain of symbolic, quantitative concepts.

Existential Intelligence was included much later. Gardner (1999) considered existential intelligence as the intelligence of understanding in a large context or big picture. It is the capacity to tackle deep questions about human existence, such as the meaning of life, why we die, what my role is in the world. This intelligence seeks connections to real world and allows learners to see their place in the big picture and to observe their roles in the classroom, society and the world or the universe. Existential intelligence includes aesthetic, philosophy, and religion and emphasizes the classical values of beauty, truth and goodness. Those with a strong existential intelligence have the ability to summarize and synthesize ideas from across a broad unit of study. The inclusion of other types of intelligence, like, spiritual and moral intelligence types creates some problems because, person’s spirituality is privileged to the privacy of the human mind and not visible.

4.2.4 Multiple Intelligence Instructional Strategies in the Classroom

The Theory of Multiple Intelligences offers eight ways of teaching and learning styles. In this regard, armed with the knowledge and application of the multiple intelligences, teachers can ensure they provide enough variety in the activities they use so that as much of their pupils' learning potential can be tapped as possible (Berman, 1998; Bas, 2008, 2010b).

The younger the learners the more physical activity they tend to need and the more they need to make use of all their senses (Brewster, Ellis and Girard, 2003). According to Berman (1998), if children can draw or visualize an image, hum it or move through it first, they may be able to more easily talk or write about it. On the basis of the Theory of Multiple Intelligences in this regard, children can also draw a picture while listening to a description, act out a nursery rhyme, follow instructions or make a shape or simple model while they listen to a description of it. This draws on learning by the ear and eye and is good for those with bodily-kinaesthetic intelligence.

There are many ways to incorporate Multiple Intelligences theory into the curriculum, and there is no set method by which to incorporate the theory. Some teachers set up learning centers with resources and materials that promote involving the different intelligences. For example, in the above scenario, Ms. Cunningham creates an area with art supplies in her classroom. Other instructors design simulations that immerse students into real life situations. Careful planning during the lesson design process will help to ensure quality instruction and valuable student experiences in the classroom.

Other instructional models, such as project-based and collaborative learning may be easily integrated into lessons with Multiple Intelligences.

Collaborative learning allows students to explore their interpersonal intelligence, while project-based learning may help structure activities designed to cultivate the nine intelligences. For instance, Ms. Cunningham uses aspects of project-based learning in her classroom by allowing students to plan, create, and process (through reflection) information throughout the Civil Rights unit, while also integrating activities that teach to the intelligences. This particular instructional model allows students to work together to explore a topic and to create something as the end product. This works well with Multiple Intelligences theory, which places value on the ability to create products. It is important for teachers to carefully select activities that not only teach to the intelligences, but also realistically mesh with the subject matter of the lesson or unit. Multiple Intelligences Theory should enhance, not detract from what is being taught.

The following list provides a survey of the techniques and materials that can be employed in teaching through the multiple intelligences (Armstrong, 1992).

Linguistic Intelligence

- lectures, debates
- large- and small-group discussions
- books, worksheets, manuals
- brainstorming
- writing activities
- word games
- sharing time

- storytelling, speeches, reading to class
- talking books and cassettes
- extemporaneous speaking
- journal keeping
- choral reading
- individualized reading
- memorizing linguistic facts
- tape recording one's words
- using word processors
- publishing (e.g., creating class newspapers)

Logical-Mathematical Intelligence

- mathematical problems on the board
- Socratic questioning
- scientific demonstrations
- logical problem-solving exercises
- creating codes
- logic puzzles and games
- classifications and categorizations
- quantifications and calculations
- computer programming languages

- Science thinking
- logical-sequential presentation of subject matter
- Piagetian cognitive stretching exercises
- Heuristic

Spatial Intelligence

- charts, graphs, diagrams, and maps
- visualization
- photography
- videos, slides, and movies
- visual puzzles and mazes
- 3-D construction kits
- art appreciation
- imaginative storytelling
- picture metaphors
- creative daydreaming
- painting, collage, visual arts
- idea sketching
- visual thinking exercises
- graphic symbols
- using mind-maps and other visual organizers

- computer graphics software
- visual awareness activities
- optical illusions
- color cues
- telescopes, microscopes, and binoculars
- visual awareness activities
- draw-and-paint/computer- assisted-design software
- picture literacy experiences

Bodily-Kinesthetic Intelligence

- creative movement, mime
- hands-on thinking
- field trips
- the classroom teacher
- competitive and cooperative games
- physical awareness and relaxation exercises
- all hands-on activities
- crafts
- body maps
- use of kinesthetic imagery
- cooking, gardening, and other "messy" activities

- manipulatives
- virtual reality software
- kinesthetic concepts
- physical education activities
- communicating with body language/ hand signals
- tactile materials and experiences
- body answers

Musical Intelligence

- musical concepts
- singing, humming, whistling
- playing recorded music
- playing live music on piano, guitar, or other instruments
- group singing
- mood music
- music appreciation
- playing percussion instruments
- rhythms, songs, raps, chants
- using background music
- linking old tunes with concepts
- discographies

- creating new melodies for concepts
- listening to inner musical imagery
- music software
- supermemory music

Interpersonal Intelligence

- cooperative groups
- interpersonal interaction
- conflict mediation
- peer teaching
- board games
- cross-age tutoring
- group brainstorming sessions
- peer sharing
- community involvement
- apprenticeships
- simulations
- academic clubs
- interactive software
- parties / social gatherings as context for learning
- people sculpting

Intrapersonal Intelligence

- independent study
- feeling-toned moments
- self-paced instruction
- individualized projects and games
- private spaces for study
- one-minute reflection periods
- interest centers
- personal connections
- options for homework
- choice time
- self-teaching programmed instruction
- exposure to inspirational/ motivational curricula
- self-esteem activities
- journal keeping
- goal setting sessions

There are research studies that explain the advantages of using multiple intelligences instructional strategies like project-based learning in educational settings (Williams, 1998; Korkmaz and Kaptan, 2000; Korkmaz, 2002; Yurtluk, 2003; Balki-Girgin, 2003; Ozdener and Ozcoban, 2004; Gultekin, 2005; Basbay, 2006; Cirak, 2006; Kemaloglu, 2006).

Out of these eight multiple intelligences, Gardner (1999) proposed that linguistic and logical mathematical intelligences are the “coin of the realm”, having traditionally dominated intelligence testing and are the ones that have typically been valued in school. Recognizing that students have different strengths and providing activities to accommodate those strengths while bridging to the weaker areas is at the heart of diversified instruction based on Multiple Intelligences Theory (Barnard and Olivarez, 2007). Students are not merely receivers of the given information; they should be encouraged to construct meaning for themselves. Since, teachers should move from the role of dispensers of knowledge into the role of facilitators of learning (Gullatt, 2008). Therefore during assessment procedure, intelligence types, creativity, problem solving and wisdom should be taken into consideration.

As Gullatt (2008) indicated, scientists have found that most thought occurs on a level well below conscious control and awareness that involves processing of a continual stream of sensory information; abstract thought is represented through metaphors that are associated with physical experiences and emotions; physical sensation and emotions are integral to thought and learning. Thus without sensation and emotion logic may not be possible for some researchers. It is supported that the arts may be used as a means of making meaning of what is learned as well as to synthesize what had been thought in schools (Eisner, 1998; Aprill, 2001; Gullatt, 2008), arts subjects are great potential partners in academic learning, arts have impact upon numerous social and cognitive dimensions across many academic disciplines (Gouzouasis, and others, 2007).

Researchers suggest two approaches for implementing Multiple Intelligences theory in the classroom. One is a teacher-centered approach, in which the instructor incorporates materials, resources, and activities into the lesson that teach to the different intelligences. The other is a student-centered approach in which students actually create a variety of different materials that demonstrate their understanding of the subject matter. The student-centered approach allows students to actively use their varied forms of intelligence. In a teacher-centered lesson, the number of intelligences explored should be limited to two or three. To teach less than two is nearly impossible since the use of speech will always require the use of one's Verbal/Linguistic intelligence. In a student-centered lesson, the instructor may incorporate aspects of project-based learning, collaborative learning, or other inquiry-based models. In such a case, activities involving all nine intelligences may be presented as options for the class, but each student participates in only one or two of the tasks.

The teacher incorporates both student-centered and teacher-centered activities into her unit on the Civil Rights Movement. The teacher-led lecture is a standard example of a teacher-centered activity. The lecture teaches to students' Verbal/Linguistic Intelligence. The viewing of the videotape is another example of a teacher-centered activity. This activity incorporates Visual/Spatial Intelligence into how the unit is learned. It is important to note that many activities, although designed to target a particular intelligence, may also utilize other intelligences as well. For example, in The teacher's classroom the students may work together on creating a mural of Civil Rights Leaders. This is a student-centered activity that directly involves Visual/Spatial intelligence, but also gives students a chance to exercise their Interpersonal Intelligence. The journal assignment, also a student-centered activity, is designed to enhance students' Intrapersonal Intelligence by prompting them to reflect on their feelings and experiences in relation to the Civil Rights movement. This activity also taps into Verbal/Linguistic Intelligence. The timeline and map assignments are student-centered activities that are designed to enhance students' Logical/Mathematical Intelligence, but they also delve into Visual/Spatial Intelligence. Students must collect and organize information for both the timeline and the map therefore using their Logical/Mathematical intelligence. In creating these items, students must think visually as well. By incorporating dance into one lesson, the teacher is able to promote awareness of her students' Bodily-Kinesthetic intelligence. By showing videos of popular dances from the time period, or inviting an expert from the community to talk about the social aspects of dance, the teacher might incorporate a teacher-centered activity. Having students learn and perform dances is a student-centered way of teaching through Bodily-Kinesthetic intelligence. The short plays that students prepare involve Bodily-Kinesthetic intelligence, as well as Interpersonal and Verbal/Linguistic intelligences. Class discussions provide an opportunity for students to exercise both areas of their personal intelligences, as well as to reinforce the subject matter.

4.2.5 Planning and Implementing Student-Centered Lessons

This type of lesson revolves around student created materials. The types of activities and assignments that support student-centered lessons can be easily designed in concert with many of the inquiry-based models discussed in the text of this book. One of the most important aspects of student-centered lessons is allowing students to make choices. Teachers should encourage students to exercise their weaker intelligences, but allow them to explore their stronger areas as well.

Listed below are steps to implement a student-centered lesson or unit:

- Carefully identify instructional goals, objectives, and instructional outcomes.
- Consider activities that you can integrate into the lesson or unit that teach to the different intelligences. Teachers need not incorporate all nine intelligences into one lesson.
- When gathering resources and materials, consider those which will allow students to explore their multiple intelligences.
- Specify a timeframe for the lesson or unit.
- Allow for considerable element of student choice when designing activities and tasks for the intelligences
- Design activities that are student-centered, using inquiry-based models of instruction.
- Provide a rubric for student activities. You might consider having students help create rubrics.
- Incorporate assessment into the learning process.

In an effort to maximize students' interest in both the subject matter and their own learning proclivities, teachers may wish to teach their students a little bit about Multiple Intelligences. Teachers can brief the class about each type of intelligence and then follow up with a self-assessment for each student. In this way, students will be able to capitalize on their strengths and work on their weaker areas. Disney's Tapping Into Multiple Intelligences website includes a self-assessment.

4.2.6 Planning and Implementing a Teacher-Centered Lesson

Structured, teacher-centered activities provide an opportunity for teachers to introduce material and establish prior knowledge and student conceptions. Teachers may lecture students, show informational videos and posters, perform drills, pose problem-solving exercises, arrange museum visits, and plan outings to concerts. There are all examples of teacher-centered activities. All of these activities integrate the Multiple Intelligences into the subject matter being taught. Teacher-centered lessons should be limited to a few activities that provide a foundation for students to later complete more exploratory tasks in which they can demonstrate understanding of the material. A teacher may choose to start an instructional unit or lesson with teacher-centered activities and then follow up with subsequent student-centered lessons. Teachers may follow these steps when designing and implementing a teacher-centered lesson :

- Identify instructional goals and objectives
- Consider teacher-centered activities that teach to students' Multiple Intelligences. In a teacher-centered lesson, limit the number of activities to two or three.
- Consider what resources and materials you will need to implement the lesson. For example, will you need to schedule a museum visit or to consult the Media Specialist for videos or other media?
- Specify a timeframe for the lesson or unit.
- Provide an opportunity for reflection by students
- Provide a rubric to scaffold student activities
- Integrate assessment into the learning process

Assessment is one of the biggest challenges in incorporating Multiple Intelligences in the classroom. The teacher's students are given the option of working on several mini-projects during the course of the Civil Rights unit. At the end of the unit, their performance is assessed through a portfolio that represents their work on these projects. It is very important for assessment to be integrated into the learning process. Assessment should give students the opportunity to demonstrate their understanding of the subject matter. One of the main goals of acknowledging and using Multiple Intelligences in the classroom is to increase student understanding of material by allowing them to demonstrate the ways in which they understand the material. Teachers need to make their expectations clear, and may do so in the form of a detailed rubric.

4.3 Attitudes

Attitudes are predispositions which have developed through a long and complex process. Kenyon (1968a) defined attitude as a latent or non-observable complex but relatively stable behavioural disposition reflecting both direction and intensity of feeling towards a particular object whether it be abstract or concrete. This definition assumed that attitude is a complex word having both direction and intensity.

Triandis (1971) accepts that it is a manner of consistency toward an object. Thomas (1971) perceived attitude as a complex of feelings, desires, fears, convictions, prejudices or other tendencies that have given a set of readiness to act because of varied experience. This definition revealed that experience is a factor in attitude formation.

Ansari (1983) stated that study problems of the students and their attitudes toward teachers, school and education are important variables needing further investigation. Vaidya (1989) explained attitude as a condition of readiness for a certain type of activity. Attitudes held by the individuals may be simple or complex, stable or unstable, temporary or permanent and superficial or fundamental. Judgments based upon insufficient facts are likely to yield wrong results and thereby develop biased attitudes.

Anastasi (1990) defined attitude as, a tendency to react favourably or unfavourably toward a designated class of stimuli. It is evident that when so defined, attitudes cannot be directly observed, but must be inferred from overt behaviour, both verbal and non-verbal. Ansari and Chowdhri (1990) have shown that study habits and attitudes of students are important variables which are closely related with the success of students in their academic work. Kırımsoy (1997) emphasized the power of culture thereby shaping our life and feeling and therefore our attitudes toward external world. Chamber (1999) asserted that learning occurs more easily, when the learner has a positive attitude toward the language and learning.

To Brown (2001), attitude is characterized by a large proportion of emotional involvement such as feelings, self, relationships in community. Parents, peers, media and teachers play a very important role in the development of attitudes. Beliefs and values are learned from the above-mentioned agents of change. At present, education is not only a matter to be solved by experts but all are involved in it. Parents' attitude can play much prominent role in the study of their children. Finally, Sarwar (2002) concluded that high academic achievers have better study habits and more positive study attitudes than low academic achievers.

4.3.1 Components of Attitudes

Attitude is a state of readiness from which motives arise. An attitude has three components, cognitive core, affective values and behavioural action tendencies.

The cognitive of attitude has belief and ideas that a person has about the attitude object. The affective component includes the feelings of like and dislike toward any object and the behavioural aspects are part and parcel of each attitude. Neil (1987) emphasis as the following components of attitudes:

(i) Cognitive Component of Attitude

We acquire most beliefs about a particular topic quite directly. Children, in particular, form attitudes through imitating or modeling the behaviour of people who play an important role in their lives. The tendency to identify with the family unit (and later with peer groups) provides a strong incentive to adopt the group attitude.

(ii) Affective Component of Attitude

Affective component of attitudes can be very strong and pervasive and tends to be rather resistant to change; it persists for some time even after a person has altered his or her opinion on a particular subject.

(iii) Behavioural Intentions

Behavioural intentions are our goals, aspirations, and our expected responses to the attitude object.

4.3.2 Development of Attitude

The process of social interaction brings about certain developments including formation of attitudes. There are various social groups which result in the development of attitudes. These would include the role of the family, cultural factors, the influence of education, the interrelationship of culture and individual experiences and the role of media in imparting information with in a particular social group.

(i) **Influence of the family:** The family is the first social group that a child communicates and interacts with in a special way. Parents play the vital role of rearing their children, and not only showing concern regarding normal physical growth and development, but also converting their children into social beings. Parents often project their own belief systems, moral values and various other attitudes. Family influences have been evident when people have migrated to different parts of the world.

(ii) **Peers Group Influence:** The power of peer pressure peaks in early adolescence. It is at the same time that parental involvement in school declines. Peers can positively or negatively affect each other's academic performance. Not surprisingly, the more successful students had friends whose grades were high, who spent more time to extracurricular activities. This quality of relationship with peers permits a new kind of interpersonal experimentation and exploration and most particularly a new kind of sensitivity, which will serve as one of the cornerstones for the development of social competence, social justice and the capacity of love. Most authorities agree that peer relationship is an essential component of child's development (Akhtar, 2001).

(iii) **Cultural Determinants:** The making of perceptual and cognitive organization, with reference of formation of attitudes, depends upon the individual's social environment. Sociologist, educators and social psychologist have laid a great deal of emphasis on the cultural influence on the development of attitudes. Religious belief of university students was a determinant as to whether they were liberal or conservative. Cultural differences among societies will be reflected in differences in attitudes among the individuals in those societies. However, when a particular culture group migrates to a different part of the world depicting entirely different cultural values their development of attitudes have been the outcome of multicultural influence.

4.3.3 Attitude towards Learning

The teacher who occupies a pivot position in the whole education systems and the success of the whole system directly hinges upon the teaching-learning activities taking place in the classroom. This may include a variety of activities, including the formulation of instructional aims and objects, identification and rearrangement of the teaching-learning materials in order to stimulate curiosity to encourage students' participation in learning activities and ensuring better learning process (Kaplan, 1982).

Attitude formation is the most important aspect of an educational system. Its basis has to be laid right from the beginning; the process starts from the cradle. Human temperament varies over a very large range and this creates a variety of interests in life. It is because of this fundamental difference of human beings that people are cut out for a variety of jobs that world offers and which have to be done if a nation has to maintain itself and advance further (Kaneckar, 1989).

Specific attitudes differ with learning experience. If the learning experience is not pleasant; the learner's attitude toward study becomes negative and negative attitude hinders the study. Successful learners adopt positive attitudes toward their study. They do not waste time or energy fretting over what they have to do. The study is aimed at comparative analysis of attitude of low and high academic achievers at secondary level.

An attitude can be defined as an enduring organisation of motivational, emotional, perceptional and cognitive processor with respect to some aspect of individual's world. It has often been observed that the object of an attitude is frequently perceived as having a goal character, which gives attitudes dynamiting character. Attitudes are a system, which can either have positive or negative involving emotions and feelings with reference to social objects and issues. Krech and Crutchfield (1948) viewed that people can hold attitudes for varying degrees of favourability toward themselves, and toward any indiscriminate aspect of their environment. There is a wide range of attitudes toward relatively abstract goals like courage, freedom, and honesty.

Choudry (1995) stated that attitude is a particular cognitive, emotional or behavioural reaction to an object, individual, group, situation or action. Johns (1996) thinks that an attitude is a fairly stable emotional tendency to respond consistently to some specific object, situation, person, or category of people. Attitudes are also much more specific than values, which dictate only broad preferences. Attitude serves as index of how we think and feel about people, objects and issues in our environment. In addition, they can provide clues to future behaviour, predicting how we will act when encounter the objects of our beliefs.

4.3.4 Attitude towards Science Learning

Several studies in Science education have investigated the relationship between student attitudes toward Science and their achievement in Science (Rennie, and Punch, 1991; Cukrowska and others, 1999; Papanastasiou and Zembylas, 2004; Tuan and others, 2005). In general, these investigations have found conflicting correlations between attitude and achievement in Science. Cukrowska and others (1999) report a positive relationship between attitudes and academic achievement in first-year chemistry (Cukrowska and others, 1999). Tuan et al. also report that achievement correlates with both attitude and motivation toward learning Science based on their study of junior high school students (Tuan and others, 2005). However, Rennie and Punch report a borderline significant correlation between subsequent achievement and student attitudes toward Science in 8th grade students (Rennie, and Punch, 1991).

Attitudes offer great possibilities for successful achievement in studies. They are an important motivator of behaviour and affect the achievement of the students. A great deal of research literature provides an evidence for positive link between attitude and achievement. Simpson and others (1994) reported a significant correlation between an affective behaviour checklist and achievement in Biology.

According to Crow and Crow (1979) a child's attitude toward his work affects his worthwhileness in his activity. A child should not be permitted to do completely as he wishes. He should be stimulated toward desirable activity through the arousal of interest in worthwhile projects. Constructive, objective attitudes encouraged during childhood serve well during adolescence.

The main aim of education is to modify the behaviour of the child according to the wants and expectancy of the society. Behaviour is composed of attitude toward the things, ideas, person or object, in the environment. The entire personality and development of the child is influenced by the nature of this attitude. Learning of a subject, and acquisition of habits, interests and other psychophysical dispositions are all affected by his attitudes. Boys and girls brought up under the influence of different economic and social factors may differ in their attitudes.

Ansari (1983) investigated these differences but the differences were not significant but found differences among students in rural and urban areas. These attitude differences investigated by Ansari (1983) and Sarwar (2002) were found to be contradictory with the former stated non significant results but the later stated significant results. Similarly the difference of study-attitude score had been investigated by many researchers and had been found significant but no body tried to find out correlation between academic performances and study attitude scores.

According to Middleton and Spanias (1990), new studies strongly indicate that teachers' attitudes and actions influence students' sense of their abilities and attitude to study Mathematics and Science. Sorge, Newton, and Hagerty (2000) in their study of Hispanic Science students said that being able to see real life models of people practicing Science changed students' attitude and beliefs about their own abilities as well as their interest in Science.

A large volume of research available has investigated the factors that contributed to students' attitude towards the study of Science, namely few factors that contributed to Science are for instance gender differences, students' attitude toward learning of Science and environmental factors.

Studies conducted in Brunei Darulssalam and Malaysia reported no significant differences in attitude of male and female students towards Science in lower and upper secondary classes. It is reported from studies done in Brunei that attitude of the upper secondary male and female chemistry students were comparable (Dhinsa and Chung (1999). Later in their recent study on Bruneian students, Dhinsa and Chung (2003) reported that there were no gender differences in attitudes towards and achievement in Science of students in coeducational schools.

Moreover Science is regarded as a less popular subject among students. A study in Welsh schools obtained from a Likert questionnaire shows that, out of the four core subjects: Science, English, Mathematics and Technology - Science is the least popular (Hendley, Parkinson, Stables and Tanner, 1995). This view is confirmed by a smaller scale qualitative study based on interviews with 190 students who responded that, Science is the subject that they like least (Hendley, Parkinson and Stables, 1995). Thus it is felt important to investigate the relationship of attitude toward learning of Science and academic performance in Science of students at secondary level and thus the inclusion of the variable, attitude toward learning of Science in the present study.

4.4 Academic Achievement

The term 'Achievement' denotes the knowledge attained or skills developed in the school subjects and these are usually designated by test scores (or) marks assigned by teachers or both. However the term 'achievement' has a broader and refers to the acquisition of all behavioural changes in the cognitive, affective and psychomotor domains. Achievement contributes strongly to one's own E grit-esteem. It is also important in gaining the esteem of others.

Achievement is a task oriented behaviour that allows the individual's performance to be evaluated according to some internally (or) externally imposed criterion that involves the individual in competing with others or with some standard of excellence. The assumption "knowledge is power" becomes meaningless when the individual possessing it fails to utilize it to the maximum benefit of mankind.

4.4.1 Achievement as an end Product

Achievement is the end product of all endeavours. The main concern of all educational efforts is to see the learner achieve. The whole educational system aims at the academic achievement of students though various other outcomes are also from the system.

Achieving as a goal is rewarding almost for everyone. For some people, the achievement of a goal takes on special importance. They enjoy working to achieve something whether it is in school, in work, or in community service. When they a goal they immediately set a new one, a little more challenging. Such people may be said to have a need or achievement.

4.4.2 Concept of Academic Achievement

Academic achievement is the amount of knowledge derived from learning. The child gains knowledge by instructions he receives at school classrooms and are around a set of core activities in which a teacher assigns tasks to pupils and evaluates and compares the quality of their work. The school provides a wide variety of achievement experiences than does the family.

The concept of achievement has several references. It usually denotes activity and mastery, making an impact on the environment rather than fatalistically accepting it and competing against some standard of excellence. According to the dictionary of education, academic achievement means the knowledge attained or skills developed in the school subjects usually designated by teachers or both.

The under achieving child is one whose actual attainment, as indicated by his scholastic attainment in school, does not measure up to his potential achievement as indicated by his abilities. He also defined over achievers as pupils whose school attainment is in excess of expectations formed on the basis of their activities. The concept of over and under achievement do suggest that there are variables in addition to ability which have positive effects on performance and that there is no perfect positive correlation between intelligence and attainment.

Labelling of some school performances as under achievers or over achievers tends to suggest that intelligence is not the sole basis of predicting achievement and agrees that there are other variables influencing achievement. This leads us to the question of discovering other variables predicting achievement.

4.4.3 Academic Achievement and Individual Factors

Intelligence is not the only determinant of school achievement. There are other factors like motivation, interest, work habits, attitude, adjusting ability, socio-economic status and periodical characteristics which determine achievement. High achievers have greater difficulty in interpersonal relationships with peers and appeared less co-operative, more selfish, less dependable, and less sociable. In contrast under achievers are more likely to be characterized by a high level of free floating anxiety, negative self-confidence, hostility towards authority, difficulty in relating to peers combined with excessive dependence on the peer group

4.4.4 Learning and Academic Achievement in Science

Current Science curricular reform efforts throughout the world have re-focused on the necessity of teaching students to make informed and balanced decisions about how Science impacts their lives and to use scientific knowledge to solve problems (American Association for the Advancement of Science, 1993; Council of Ministers of Education, 1997; Australia, 1998; Millar, Osborne, and Nott, 1998). This type of learning is best accomplished using more student-centered active-learning strategies (e.g. peer instruction/discussion; problem- and case-based learning; peer teaching; team-based learning, and inquiry-based learning) (Crouch and Mazur, 2001; Tien, Roth, and Kampmeier, 2002; Burrowes, 2003; Knight and Wood, 2005; Smith and others, 2009).

Research in Science education indicates that this learning is enhanced when:

- students, teachers, peers, families, and the wider community hold high expectations for students' success;
- students have the opportunity to clarify their ideas, to share and compare, question, evaluate, and modify these ideas, leading to scientific understanding;

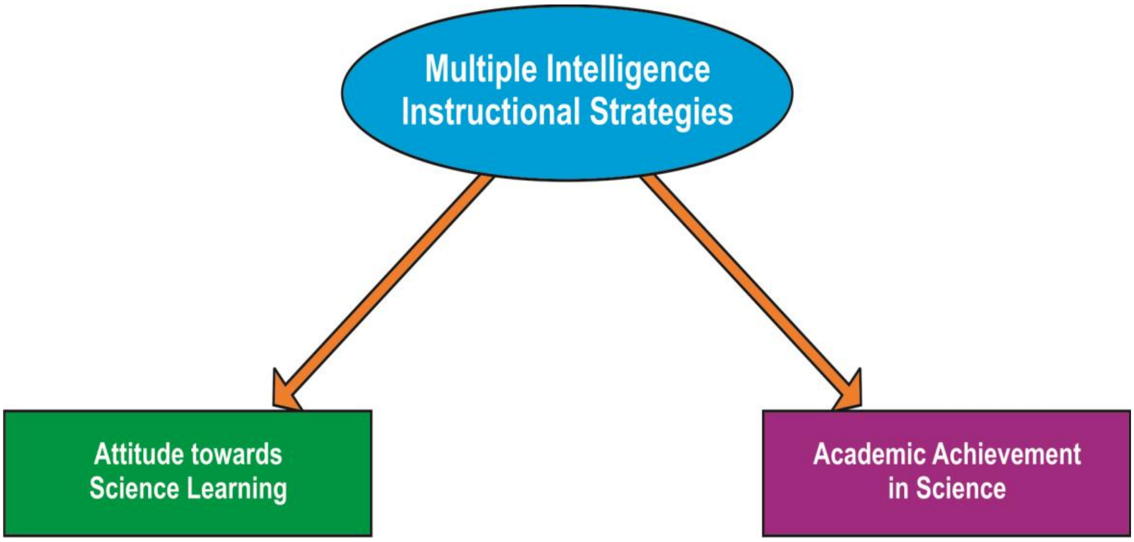
- students have opportunities to use their new ideas and skills, first in a variety of familiar contexts and later in other challenging situations;
- students are aware of effective ways in which they learn;
- students see the relevance and usefulness of Science to themselves and to society;
- teachers and students work within a supportive atmosphere of mutual respect where all the experiences, ideas, and beliefs, which students bring into the learning situation are acknowledged as a basis for learning;
- learning environments are visually stimulating and reflect contemporary Science;
- teaching strategies respond to a diversity of learning styles;
- scientific knowledge, skills, and attitudes are first introduced in contexts which are relevant and familiar to the students;
- Science is linked with other essential learning areas

Learning of Science, Mathematics, and Technology are defined as much by what they do and how they do it as they are by the results they achieve. To understand them as ways of thinking and doing, as well as bodies of knowledge, requires that students have some experience with the kinds of thought and action that are typical of those fields. Thus, to enhance the learning and ultimately the academic achievement in Science, investigation into variables such as, attitude toward learning of Science, intelligence, Science learning skills and socio-economic conditions becomes very important.

Thus, the conceptual model that has been developed to investigate the teaching performance of student-teachers at the secondary and at the higher secondary levels is presented below.

Figure - 3

Conceptual Framework of the Study



5. OBJECTIVES OF THE PRESENT STUDY

(i) To prepare a lesson plan using multiple intelligences instructional strategies;

(ii) To investigate the possible difference between the pre-test scores of attitude towards Science learning among students in Experimental and Control groups;

(iii) To investigate the possible difference between the pre-test scores of academic achievement in Science among students in Experimental and Control groups;

(iv) To investigate the possible significant difference between the pre-test and post-test scores of attitude towards Science learning among students in Experimental Group;

(v) To investigate the possible significant difference between the pre-test and post-test scores of attitude towards Science learning among students in Control Group;

(vi) To investigate the possible significant difference between the pre-test and post-test scores of academic achievement in Science among students in Experimental Group;

(vii) To investigate the possible significant difference between the pre test and post-test scores of academic achievement in Science among students in Control Group;

(viii) To investigate the possible difference between the post-test scores of attitude towards Science learning among students in Experimental and Control groups and

(ix) To investigate the possible difference between the post-test scores of academic achievement in Science among students in Experimental and Control groups.

6. STATEMENT OF THE PROBLEM

Effect of Multiple Intelligence Instructional Strategies on Attitude towards Science Learning and Academic Achievement in Science among Standard IX Students

7. REVIEW OF RELATED LITERATURE

A survey of related, literature is and essential step to get a clear understanding of the problem, which also broadens the general concepts and principles. According to Aggarwal (2001), a survey at related literature implies locating, reading and evaluating reports of research as well as casual observation and opinions that are related to the individual's planned research project. The study of related literature saves a researcher from working on a worked topic. Besides helping to select and ideal problem it helps to adopt suitable design for the study. Understanding the limitations of the pervious studies, it ensures perfection in the study to be made. With these aims in view the investigator has reviewed some of the past studies and has been compiled in the present section. The review is grouped as follows:

- Studies related to Multiple Intelligence Instructional Strategies and Attitude towards Learning
- Studies related to Multiple Intelligence Instructional Strategies and Academic Achievement

7.1 Studies related to Multiple Intelligence Instructional Strategies and Attitude towards Learning

Students who realize that they have intelligences in which they excel-even if they are not the traditional intelligences-will develop a more positive attitude toward school learning. Many educators have argued that multiple intelligences improve students' attitudes (Smagorinsky, 1991, 1995a, 1995b, and 1996; Campbell, Campbell, and Dickinson, 1992; Campbell, 1997), but they have not supported their arguments with research. For example, Campbell and others (1992) say that some of the by-products of multiple intelligences include better attitudes, fewer behavior problems, improved self-concept, development of cooperation and leadership skills, and development of a love of learning. According to these educators, multiple intelligences has an impact on the whole person (Campbell and others, 1992). If the whole student is considered, other areas, including attitude and academics, also improve (Campbell and others, 1992). According to Smerechansky-Metzger (1995), multiple intelligences ultimately become a motivational tool which supplies the self confidence required to achieve academic success.

A number of educators argue that multiple intelligences help students build positive attitudes toward learning in class. For example, according to Emig (1997) students who are using their areas of strength to learn feel more competent and confident and enjoy the challenge of acquiring new information. They participate more freely and retain more information because they can more easily see connections.

Eilers and others (1998) studied the loss of commitment to schoolwork exhibited by middle level students and the effect of a variety of strategies on students' learning and on students' attitudes toward themselves as learners.

The implementation of different instructional strategies and their affects on student attitudes toward learning was investigated by Lovato (2006) in two Northern Humboldt High School remedial Mathematics classes. The study explored and analyzed different types of pedagogy: and their affects on student's attitudes toward learning. The research was a sample of convenience conducted in Algebra 1b classes on one of the campuses of a joint high school district. The sample included approximately sixty students whose parents have given consent to participate in the study. An 18-item, Likert-type questionnaire along with four demographic questions were developed, piloted and implemented in the Algebra 1b classes. A multi-variate analysis was employed as the quantitative and qualitative measure for comparing student attitudes and the type of pedagogy being presented. The results emphasized the fact that students when exposed to differentiated instructions not only helped students to perform academically better but their attitude towards learning of the subject like Mathematics also improved significantly.

The purpose of the study conducted by Zakaria (2010) was to determine the effect of cooperative learning on Mathematics achievement and attitude towards Mathematics. This quasi-experimental study was carried out on two form one classes in Miri, Sarawak. One class (n = 44) was assigned as an experimental group and the other (n = 38) was assigned as a control group. The two groups were pre-tested prior the implementation. At the end of the study, post test was given, while daily quiz was used as a tool for formative testing. Teaching and learning process was carried out for two weeks. Data were analyzed using the t-test to determine performance by comparing the mean of the post test for treatment and control group. The results of this study showed that cooperative learning methods improve students' achievement in Mathematics and attitude towards Mathematics.

Evaluation

Differentiated instruction supports the classroom as a community, accommodating differences and sameness (Bosch, 2001; Tomlinson, 2003; Brimijoin, Marquissee, and Tomlinson, 2003; Lawrence-Brown, 2004). It allows for the creation of an environment in which all students can succeed and derive benefit (Lawrence-Brown, 2004; Tomlinson, 2003). Students differ in three important ways – readiness, attitudes, interests and learning profiles. In a differentiated classroom, the teacher is obliged to attend to these differences in order to maximize the learning potential of each student in that classroom (Tomlinson, 2000b, 2001a).

Student interests vary and these interests can become effective tools to support learning in the differentiated classroom (Tomlinson, 2001a). Tomlinson (2001a) sees student interests as a powerful motivator, which wise teachers could take advantage of within the differentiated classroom. Activities and discussions that are built around students' concerns, attitudes and their life experiences allows the curriculum to become more meaningful to students (Tomlinson, 2000b, 2001a; Bosch, 2001; MacGillivray and Rueda, 2001; McBride, 2004). Allowing for student interests within the learning community, ensures that even marginalized students find a place (Lawrence-Brown, 2004). Most students, even struggling learners, have aptitudes and passions, providing an opportunity within the classroom for them to explore and express these interests, mitigates against the sense of failure previously experienced by these students (Lawrence-Brown, 2004). Thus understanding the need and importance of different instructional strategies and dearth of studies that have established the effect of differentiated instructional strategies on attitude of students towards learning has made this investigation very essential.

7.2 Studies related to Multiple Intelligence Instructional Strategies and Academic Achievement

According to several studies (Ferguson, 1991; Darling-Hammond, 2000) 40% to 60% of the variance in student test scores can be attributed to teacher qualifications. According to body of research (Edmunds, 1979), effective teachers are guided by a preplanned curriculum and clearly inform students of the objectives and what is expected from them. Teachers hold high expectations for students and provide the necessary scaffolding to help students succeed. Students are given challenging, yet doable tasks that are clearly aligned with objectives and assessment. Lessons are geared to give students success opportunities and are clear and focused, without digression. Feedback is immediate, parents are involved, student learning is closely monitored, and students are re-taught when necessary. Positive student teacher relationships are prevalent and students are well informed about behavior expectations. Routines are well established. Consequences are swift and fair, and incentives reward excellence.

Between the Effective Schools (Edmunds, 1979) research and Ganges Instructional Lesson Line (Joyce, Weil, and Calhoun, 2004), wherein essentially the activity of teaching is sometimes mistakenly reduced only to direct instruction and talking to students, many teacher education programs and school districts have developed check sheet evaluation forms that tend to reward the lecture format in middle and high school instruction. Lecture and recitation can be strong teaching tools, when well implemented, because whole class instruction can cover more material in a relatively short time. Teachers, who feel pressed to do just that under high-stakes accountability systems, can effect a narrowing of the curriculum, moving higher order academic skills into the background (Koretz and Barron, 1999). In fact, when standards are heavily weighted toward facts, rather than concepts and ideas, teachers feel compelled to do more drill work with students. Drill work has its place in education, but without deeper levels of understanding of the material and the rationales for needing to know the various facts, some students are reluctant to engage themselves enough to learn (Good and Brophy, 1996).

Marginally achieving students rarely hold information from traditional instructional strategies like, lecture/recitation formats for more than short term retention, if at all. The reason for the poor retention from traditional strategies formats may have a number of causes, depending on the particular student. Learning styles, second language issues, ability levels, or a lack of previous knowledge are all factors that can obscure learning. The old adage that, the more you know the easier it is to know more, has merit. Learners of all ages need to be exposed to a broad range of experiences, in and out of the classrooms, in order to make sense of new material (Good and Brophy, 1996).

Good teaching, especially when working with marginal students, requires moving from the familiar to the unfamiliar, from the concrete to the abstract, and helping students exercise their more complex intellectual processes in meaningful contexts. Low performing students, in particular, often need to see the relevance of what they are learning and need concrete experiences and active learning to bring ideas and concepts to life (Bonwell and Eison, 1991; Good and Brophy, 1996).

Active learning is an umbrella term for a range of instructional strategies that support motivation to learn through the students' active engagement. Active learning can take the form of dialogue with the teacher, cooperative learning, other small group formats, discussion, role play, debate, problem-based instruction, group presentations or dramatizations, simulations, peer teaching, and a host of other activities. One of the primary facets of active learning is that it is highly interactive (Bonwell and Eison, 1991). To be actively involved, under the term active learning, students are utilizing high-order thinking skills as suggested by Bloom's levels of analysis, synthesis, and evaluation (Good and Brophy, 1996).

Most research linking multiple intelligences instruction with students' achievement has been done on a small scale with only a few students studied at a time. A study by Smagorinsky and Coppock (1994) analyzed the composing process of students by conducting stimulated recall interviews following one student's creation of an artistic text that represented his interpretation of the relationship between two central characters in a short story. The findings suggested that non-linguistic texts aid in the construction of meaning (Smagorinsky and Coppock, 1994).

Meyer (1997) studied fourteen fifth and sixth grade students' challenge seeking during project-based Mathematics instruction in one classroom. They drew on five areas of research: academic risk taking, achievement goals, self-efficacy, volition, and effect. They reported on the effects of fifth and sixth grade students' motivation and that although the surveys were useful in characterizing general patterns of challenge seeking, more individual and contextualized information was necessary for understanding how to support students engaged in challenging academic work, such as project-based learning. According to the results, project-based learning increased the students' achievement level.

Eilers and others (1998) used activities based on the multiple intelligences as one of their intervention strategies. They found a modest increase in student achievement, as well as increased confidence and self-image, as a result of MI activities and other strategies.

Osciak and Milheim (2001) focused on multiple intelligences strategies which could be implemented with web-based instruction. They stated that utilizing the principles of Multiple Intelligences Theory and the dynamics of the Internet allow instructional designers to develop learning experiences that are diversified, exploratory, guided, and soundly constructed. They also mentioned that using Web designs allows the educators to create instruction that meets and exceeds expectations. Then, opportunities are geared to various intelligence types and appeal to a diversity of language learners. They also argued that Web-based instruction is a much flexible type of instruction on the basis of which all intelligences could be represented and cultivated regardless of the physical location of the student.

Batulayan (2001) explored the relationship of multiple intelligences to the academic achievement of grade six pupils in Northern Luzon Mission. The theory developed by Howard Gardner was the basis of the theoretical concept. Data were obtained from 310 pupils who were enrolled for the SY 2001 – 02 in the 24 church schools operated and supervised under the Northern Luzon Mission. This comprised 61.5% of the total population of 504 pupils in 44 schools. Participants responded to the Multiple Intelligences Questionnaire (MIQ), a self-construct instrument, which was personally administered by the researcher. It contains 70 items with 10 questions each representing the seven intelligences namely: verbal-linguistic, logical-mathematical, bodily-kinesthetic, musical, visual-spatial, intrapersonal and interpersonal.

The statistical analyses of the study employed mean, frequency, percentage, multiple regression and chi-square. Major findings in the study led to the following conclusions: The most dominant intelligences of the grade six pupils were logical-mathematical, musical, bodily-kinesthetic, and intrapersonal. The academic achievement level was 84. 09%, which is average in the grading standard of the Mission.

The study also found that logical-mathematical and intrapersonal intelligences were related to the academic achievement with a contribution of 9.25%. The other five intelligences, namely: verbal-linguistic, visual-spatial, musical, bodily-kinesthetic, and interpersonal did not have significant relationships to academic achievement. Gender among the grade six pupils does not confine one to a certain specific intelligence. The study found that male and female participants in the study did not have significant correlations in their multiple intelligences.

Rubado (2002) worked with a group of middle school students (n = 17) who were having difficulty learning the general education curriculum and were at risk of failing, but were not being served by the traditional special education program. To meet their needs, she began integrating multiple intelligences into her instructional practices and found that students naturally began to identify their intelligences. Over the course of the 10-week study, Rubado’s students participated in numerous activities intended to foster understanding of intelligence. The students completed questionnaires, practiced using each intelligence in their school work, created songs and collages, analyzed a popular television show for the use of intelligences, and discussed emotions students had with each intelligence (Rubado, 2002). Other teachers then began integrating multiple intelligences into their instructional practices and found that their students readily began to identify their intelligences in their work. Rubado found that students, through the process of self-reflection, began to identify their areas of strength in the context of multiple intelligences. That is, they were able to identify which intelligences would enhance their performance. More than that, students also understood that they had the ability to use all eight intelligences, even if they didn't yet understand the complexity of each. For example, there were students who were talented public speakers who felt that they were weak in verbal/linguistic intelligence most likely because they didn't like to read. Through the use of a self-evaluation rubric, the students, many of them with special needs, discovered that they were using all the intelligences effectively, depending on the situation — they realized they were better-rounded than they had initially believed (Rubado, 2002). Most importantly, however, the researchers found, as others (Waldron and Van Zandt Allen, 1999; Kornhaber, Fierros, and Veenema, 2004) had before, that the students realized that there are multiple ways to learn and that they possessed multiple types of academic strengths and life skills.

Chien and Hwang (2004) investigated the relationship between multiple intelligences of elementary school students and project-based learning. The sample comprised of 120 students from 6 primary schools, divided into two groups. The experimental group was sub-divided in accordance with students' multiple-intelligences. The control group was sub-divided in accordance with their academic achievement. The result showed that assessment of the multiple-intelligence based group was superior to that of academic-achievement based group. It was also found that there was a significant positive correlation between multiple intelligence and project – based learning portfolio assessment.

Lee and Hwang (2004) investigated the relationship between the multiple intelligences of elementary school students and project-based learning via the Internet, so called Internet project-based learning. The researchers collected 120 students from 6 primary schools; they were randomly separated into two groups. The experimental group was sub-divided in accordance with students' multiple-intelligences. The control group was sub-divided in accordance with academic achievement. After data analysis it was found that assessment of the multiple-intelligences-based group was superior to that of academic-achievement-based group. More specifically: the portfolio assessment of the multiple-intelligences-based group was superior to that of the academic-achievement-based group; there was a significant positive correlation between multiple intelligences and project-based learning process assessment; there was a significant positive correlation between multiple intelligences and project-based learning portfolio assessment. Furthermore, the scale of multiple intelligences was able to predict project-based learning assessment and project-based learning portfolio assessment. So, different senses of a term will influence Internet Project-based learning results. The student's multiple intelligences and Internet project-based learning results can be used to evaluate process assessment.

In the study conducted by Aborn (2006) he proposed that practitioners, administrators, and parents should consider this malleable definition of intelligence, as opposed to a fixed one. They should broaden their views of what they understand intelligence to be, and not allow it to interfere with the belief they hold in the success of each child with whom they work. He strongly encouraged the reader to learn more about the Multiple Intelligences Theory, and then use it to help weave a beautiful tapestry of how students learn. Education has been the platform of many individuals in and out of politics. Often, the topic is focused on school test scores, student achievement, and the demand for highly qualified teachers in the classroom. The No Child Left Behind legislation mandates school systems to adhere to a curriculum that promotes academic growth. Therefore, teachers must incorporate strategies that will lead to increased academic performance.

The central task of the researches conducted by researchers like Ranade (2006) was to develop comprehensive Computer Assisted Instructional (CAI) Packages based on the concept of Multiple Intelligences (MI) and its application to teaching. The packages were developed to fulfill two objectives: to introduce teacher-educators and student-teachers to the relatively new concept of Multiple Intelligences Approach to teaching, and to expose them to a good model of the use of a slideshow presentation for teaching. The CAI packages were found to produce significantly higher achievement in terms of content when tested on a batch of about 25 teacher-educators. All participants reported that the packages were very well designed and effective in bringing about learning, and also that the introduction to this new approach would help them to think more innovatively about lesson planning. In another study which was a continuation of the first study, the effectiveness of CAI (on MI) used as a visual aid in teaching was compared with traditional lecture method, and use of CAI was found to lead to significantly higher achievement (at 0.01 level of significance) than the traditional lecture method.

Research was conducted by Al-Balhan (2006) with middle-school Kuwaiti children to assess the effectiveness of student multiple intelligence styles in predicting students' improved reading skills through academic performance. A group of middle school students who had received first quarter grades and enrolled in an after-school tutoring program were studied, with half of the students in a traditional tutoring program and the other half in a Gardner multiple intelligence style-tutoring program. Results show that the students in the experimental group (mean = 48.99), whose multiple intelligence was applied to learning, performed better overall for the academic year than the students in the control group (mean = 45.30) who studied using traditional teaching methodology. Gender, school type, and residential living area were all analyzed within the experimental group. The experimental group results show that, with regards to grades during each quarter period, female students attending private institutions living in suburban areas had greater reading improvement.

Elmas (2006) conducted a study to compare the effectiveness of multiple intelligence theory based instruction and traditional Science instruction on 9th grade students understanding of chemical bonding concept and attitudes toward Chemistry. The sample consists of 50 ninth grade students from two classes. 25 students were assigned as Experimental Group and the other 25 as Control Group. The tools used consist of an achievement test about chemical bonding concept which consisted of 25 items. The achievement test along with the attitude scale toward Chemistry developed by Geban et al., were administered. The results showed that students who were instructed by multiple intelligences theory based instruction were achieved higher than the ones which were instructed by the traditional Science instruction about chemical bonding concept. There was also a significant difference between the students instructed with Multiple Intelligences Theory Based Instruction (MITBI) and the students instructed with Traditional Science Instruction (TSI) with respect to the attitudes of students toward Chemistry. There was no significant difference between the attitudes and achievement of female students and that of male students.

Yildirim and others (2006) conducted an experimental research to investigate the effects of the cooperative learning method supported by multiple intelligence theory on elementary 4th grade students' academic achievement and retention in their maths course. The subjects of study consisted of 46 4th grade students from an elementary school in the Yüregir district of Adana. For this research, a control group was taught using the whole class teaching technique and an experimental group was taught using the cooperative learning method supported by multiple intelligence theory. The study was carried out over seven weeks. The measurement instrument used in the study was a Mathematics achievement test. This instrument was used as pre-test, post-test and retention test with the experimental and control groups. Furthermore, prior to the study TIMI was administered to all participants. In conclusion, it was found that there were differences in achievement between the experimental and control groups. From this result, it can be said that the cooperative learning method supported by multiple intelligence theory is more effective than the whole class teaching on achievement in Mathematics. At the same time, it was found that there are no significant differences in their retention.

In the study conducted by Pociask and Settles (2007) the students targeted were third and fourth grade students with learning-disabilities and seventh-eighth grade Science students who exhibited poor test scores, motivation, and behaviors that negatively impacted their learning. The objective of this study was to change the level of student engagement in order to increase their academic achievement by incorporating Multiple Intelligences strategies into daily lessons. The study took place from September 2006 to January 2007. The purpose of the study was to determine if incorporating multiple intelligences would help raise test scores and improve student behaviors. Data was collected through observation checklists, parent surveys, and Multiple Intelligence (MI) surveys as both pre- and post-intervention measurement tools. Students completed reflective journal entries over seven weeks to help identify their multiple intelligence strengths and how those affect their learning. Collated data is illustrated through graphs throughout the paper followed by narrative analysis. The two teacher researchers in this project found students to be more engaged in the learning process as a result of the strategies introduced in their classrooms. This research indicated that incorporating MI into daily lesson improved students' self esteem, increased retention rates, enhanced motivation for learning, and decreased incidences of off-task behaviors. Students appeared to be more focused and engaged on assessments at the end of the study as a result of the use of various MI strategies. Students' learning experiences would be greatly enhanced if teachers taught to multiple student intelligences and incorporated alternative assessments.

In the experimental study, conducted by Isik and Tarim (2009) the effects of the cooperative learning method supported by multiple intelligence theory (CLMI) on elementary school fourth grade students' academic achievement and retention towards the Mathematical Science course were investigated. The participants of the study were 150 students who were divided into two experimental (used CLMI) and two control groups (used traditional method). "Mathematical Science Achievement Test," "Teele Inventory for Multiple Intelligences" and "Personal Information Form" were used as the measurement instruments of the study. The findings of this research have indicated that CLMI has a more significant effect on academic achievement than the traditional method. Yet, regarding the retention scores, CLMI has not significant effect on retention.

Cheryl (2010) conducted a study during the first semester of the school year using descriptive method of research. The sample consists of medically diagnosed and recognized students with visual and hearing impairment. The data collected from the sample using intelligence checklist and informal interviews showed that both the students with visual and hearing impaired perform satisfactorily in their academic performance when exposed to different teaching strategies. The multiple intelligences manifested by the students with visual and hearing impairments had varied effect on their academic performance.

The aim of the research conducted by Bas and Beyhan (2010) was to investigate the effects of multiple intelligences supported project-based learning and traditional foreign language-teaching environment on students' achievement and their attitude towards English lesson. The research was carried out in 2009 – 2010 education-instruction year in Karatli Sehit Sahin Yilmaz Elementary School, Nigde, Turkey. Totally 50 students in two different classes in the 5th grade of this school participated in the study. The results of the research showed a significant difference between the attitude scores of the experiment group and the control group. It was also found out that the multiple intelligences approach activities were more effective in the positive development of the students' attitudes. At the end of the research, it is revealed that the students who are educated by multiple intelligences supported project-based learning method are more successful and have a higher motivation level than the students who are educated by the traditional instructional methods.

Evaluation

Applying Multiple Intelligence Theory means preferring student centered teaching methods rather than teacher centered teaching methods. In this respect, one of the areas where Multiple Intelligence Theory is applied is the cooperative learning technique. Kagan and Kagan (1998) mentioned that unstructured activities they had developed within the frame of cooperative learning were based on the Multiple Intelligence Theory. The unstructured activities recommended by Kagan and Kagan (1998), are appropriate for all intelligence areas, easy to apply, and also constructed in dimensions that comply with the Multiple Intelligence Theory. In other words, with cooperative learning methodology, both intelligence areas of students can be improved and also new connections in the brain can be provided by letting them share differences with each other (Kagan, Kagan and Kagan, 2000). Thus, understanding the influence of multiple intelligences instruction strategies on attitude towards learning and achievement of students and dearth of studies in the Indian context, especially, in the area of Science makes it very important for the investigator to investigate the effect of multiple intelligences instructional strategies on attitude towards learning of Science and academic achievement in Science.

8. METHODOLOGY OF THE PRESENT STUDY

Methodology is an important aspect of any kind of research work. Each research study has its own objectives. The procedure adopted by the researcher for the investigation is known as methodology.

8.1 Method of Investigation

Methodology is an important aspect of any kind of research work. Each research study has its own objectives. The procedure adopted by the researcher for the investigation is known as methodology. Research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. In fact, the research design is the conceptual structure within which research is conducted and it constitutes the blue print for collection, measurement and analysis of the collected data. As such the design includes an outline of what the research will do from framing the hypotheses and its operational implications to the final analyses of the data.

Experimental method is employed in the present research to collect, analyze and interpret the data. Data collected from the select sample was scored and subjected to statistical processing.

8.2 Research Design

The present study envisages the effect of multiple intelligences strategies on attitude towards Science learning and academic achievement in Science among students using a pre and post experimental design.

The design has been drawn as follows:

Groups	Sample	Pre-test Measures	Teaching	Post-test Measures
Experimental Group	43 students	Attitude towards Science Learning & Academic Achievement in Science	Multiple Intelligence Instructional Strategies	Attitude towards Science Learning & Academic Achievement in Science
Control Group	47 students	Attitude towards Science Learning & Academic Achievement in Science	Traditional Instructional Strategy	Attitude towards Science Learning & Academic Achievement in Science

This design was tested with the following experimental procedure.

E = A -------------- M ----------------B

C = A -------------- T ----------------B

Where E = Sample chosen for the Experimental Group

C = Sample chosen for the Control Group

A = Pre-test measures of attitude towards Science Learning and Academic Achievement in Science

B = Post-test measures value pattern of students

M = Multiple Intelligence Instructional Strategies

T = Traditional Method of Instructional Strategy

This instructional treatment was conducted over four weeks in the academic year 2010-2011 in a select matriculation school. Two sections of standard IX were enrolled in the study. The classes were selected randomly.

First, topics in standard IX Science text book were selected and a pre-test was conducted to estimate the attitude towards Science learning and academic achievement in Science among these students and to check if there is any significant difference between the two groups with regard to attitude towards Science learning and academic achievement in Science.

Next, drawing on relevant research, all activities were developed by the researchers. Lesson plans for the procedure were based on Gardner's (1993, 1999) suggestions on teaching for a deep learning.

In the next step, the students in the control group were instructed only with traditionally designed learning material. Most of the time, the teacher presented the topics and the students listened to their teacher and answered the questions asked by their teacher. At the same time they carried out activities in their text-books.

However, the instructions for the experimental group varied. Different types of activities were taken for different types of intelligences of students. Lesson plans were prepared with various activities based on multiple intelligence supported learning methods.

8.3 Variables

The variables chosen for investigation in the present study are instructional strategies, attitude towards Science learning and academic achievement in Science.

8.4 Hypotheses

Based on the review of related literature and objectives of the present study, the following hypotheses have been formulated:

(i) There is no significant difference between the pre-test scores of attitude towards Science learning among students in Experimental and Control groups;

(ii) There is no significant difference between the pre-test scores of academic achievement in Science among students in Experimental and Control groups;

(iii) There is no significant difference between the pre-test and post-test scores of attitude towards Science learning among students in Experimental Group;

(iv) There is no significant difference between the pre-test and post-test scores of attitude towards Science learning among students in Control Group;

(v) There is no significant difference between the pre-test and post-test scores of academic achievement in Science among students in Experimental Group;

(vi) There is no significant difference between the pre test and post-test scores of academic achievement in Science among students in Control Group;

(vii) There is no difference between the post-test scores of attitude towards Science learning among students in Experimental and Control groups and

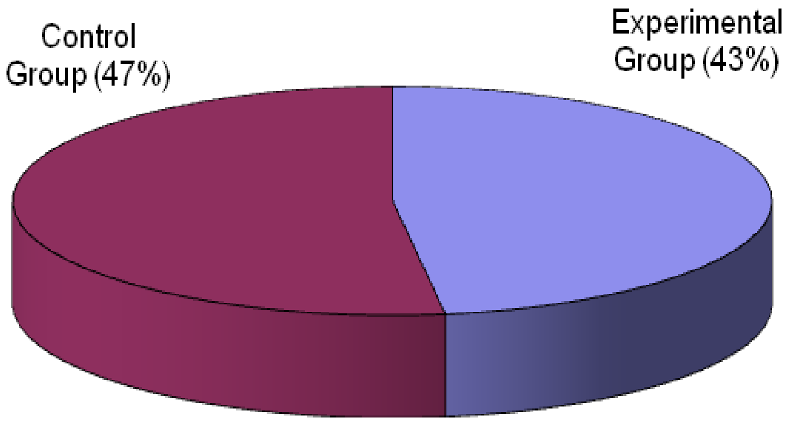
(viii) There is no difference between the post-test scores of academic achievement in Science among students in Experimental and Control groups.

8.5 Sample Characteristics

The chosen sample is 90 students from standard IX. 43 students in Experimental Group and 47 students in Control Group.

Figure-4

Group-wise Distribution of Sample



8.6 Research Tools

Every descriptive type of research employs one or more tools for collecting valid and reliable data. The major types of tools of research are the questionnaire schedule, test inventories and scales. In the present study Attitude toward Learning of Science Scale (Grewal, 1972) was used to assess the attitude of students towards learning of Science and another tool was developed to measure the academic achievement in Science.

8.6.1 Tool-1: Attitude toward Learning of Science Scale (Grewal, 1972)

Attitude toward Learning of Science Scale (Grewal, 1972) was chosen in the present study as it is a scale to assess attitudes of students done in the indigenous settings. It was also easy to administer and directions given were simple. The rating scale consists of 20 items relating to attitudes of students toward learning of Science possessed by students contributing the effective learning and performance in Science.

Administration

The test was a paper pencil test and hence administered as a group test with the following instructions.

"Given below are a series of statements that represent your attitude towards learning of Science. Please read the following statements one by one carefully. Each statement can be responded in 5 alternatives viz., Strongly Agree, Agree, Neither Agree nor Disagree, Disagree and Strongly Disagree. According to your view, think and decide which alternative suits you well. Opening upon your decision, put a tick (✓) in front of each statement in the columns provided. There is no time limit, however, do not spend too much time pondering over a single item. I expect an honest response from you as it goes a long way in building research knowledge. Thank you".

There was no time limit and the test was scored according to the scoring instructions.

Scoring

The scoring ranged from minimum of 20 to maximum of 100. The scoring of this scale is done with the corresponding values.

Strongly Disagree	-	1
Disagree	-	2
Neither Disagree nor Agree	-	3
Agree	-	4
Strongly Agree	-	5

8.6.2 Tool-2: Science Test

In order to collect the data related to academic achievement of the students in Science, a Science Test was developed by the researcher. A multiple choice test including fifty items was developed and the reliability and validity of the test were established. This test is used to measure the students' academic achievement in select standard IX Science topics. The topics chosen for the present study are Force and Motion, Newton's Law of Motion and Structure of Atom. The test items developed to measure the objectives of academic achievement levels of the students in Science lessons in standard IX were based on the Objective-wise and Content-wise weightage tables that are presented hereunder.

Table-1a

Objective-wise Weightage Table

Objective	Number of Questions	Marks Alloted
Knowledge	26	26
Understanding	11	11
Application	4	4
Analysis	4	4
Synthesis	1	1
Evaluation	4	4
Total	50	50

Table-1b

Content-wise Weightage Table

Content	Number of Questions	Marks Allotted
Force and Motion	17	17
Newton's Law of Motion	17	17
Structure of Atom	16	16
Total	50	50

The test was administrated to a total number of 90 standard IX students in a select matriculation school.

Administration

The achievement test was administered as a group test with the following instructions.

"Given below are 50 multiple choice questions pertaining to the topics Force and Motion, Newton's Law of Motion and Structure of Atom from your Science text book. Read the questions carefully and tick (√) the correct answer. You are expected to answer all the questions. The duration of the test will be 60 minutes. You are expected to complete the answering all the questions in 50 minutes and check the answers in 10 minutes and then handover the test paper".

The students were made to sit comfortably and the test paper was distributed.

Scoring

The scoring ranged from minimum of 0 to maximum of 50. Each correct answer was allotted 1 mark and the wrong answer was allotted 0 mark. The correct answer to each question is given in the table below:

Question Number	Correct Answer	Question Number	Correct Answer	Question Number	Correct Answer
1	b	21	c	41	a
2	b	22	a	42	b
3	b	23	b	43	a
4	b	24	c	44	a
5	a	25	a	45	a
6	a	26	a	46	a
7	b	27	b	47	b
8	b	28	b	48	a

Question Number	Correct Answer	Question Number	Correct Answer	Question Number	Correct Answer
9	a	29	a	49	a
10	a	30	a	50	b
11	a	31	b		
12	b	32	c		
13	a	33	b		
14	a	34	a		
15	c	35	a		
16	b	36	b		
17	a	37	c		
18	a	38	b		
19	a	39	a		
20	b	40	b		

9. PILOT STUDY

A pilot study was conducted with 30 students to eliminate any ambiguities and to find out if students had any difficulty in responding

9.1 Reliability

The reliability of a tool depends upon the consistency with which it gauges the particular trait when applied at different points of time. It is one of the characteristics required of a scientific tool.

To find the reliability of the Science Test, test-retest method was adapted. The same test was given on two occasions at an interval of six weeks to a group of 30 students selected at random. The coefficient of correlation between the two sets of scores gives the reliability coefficient. Thus reliability was established and was found to be 0.86, significant at 0.01 level.

9.2 Validity

The question of validity of a tool concerns what the tool measures and how well it does so. A research tool is highly valued if it measures effectively the property it purports to measure. The validity of Science Test has been determined in the following manner:

(i) Face Validity

Face validity refers, not to what the test necessarily measures, but to what it appears to measure (Anastasi, 1957). The present Achievement in Science Test has face validity and the experts agreed that the items are relevant to the objectives. The test was approved by subject experts and experienced educationists.

In this context it was thought appropriate to consider the index of reliability as a validity measure by computing the square root of the reliability (Garrette, 1979). Accordingly it was 0.87 which is highly significant.

10 PREPARATION OF THE ACTION PLAN

The action plan was prepared for teaching a Science lesson using multiple intelligences instructional strategy. Topics were selected from Physics in standard X. The action plan was prepared in the following manner. The plan was divided into four columns and for each column a suitable heading was given.

Concept	Content	Learning Experience	Evaluation

The topics selected in Standard IX Physics are Force and Motion, Newton's Law of Motion and Structure of Atom. The plan of action based on instructional strategies supported by multiple intelligences for the above selected standard IX Science topics is given in Appendix-II.

11. MAIN STUDY

Printed copies of the booklet which consisted of the Personal Data sheet together with the Attitude toward Learning of Science Scale (Grewal, 1972) was administered to 90 students studying in standard IX from a selected school. It was ensured that the 90 students selected for the main study did not participate in the pilot study.

The Attitude toward Learning of Science Scale (Grewal, 1972) and Science Test were administered personally by the investigator before teaching the selected topics using multiple intelligence instructional strategies as a pre-test. The investigator personally taught the lessons for a period of one month using multiple intelligence instructional strategies. The Attitude toward Learning of Science Scale (Grewal, 1972) and Academic Achievement in Science Test were once again administered personally by the investigator after teaching. The Investigator ascertained that all students responded to all items as per the instructions. On an average each student took about 30 minutes to respond the attitude scale and 60 minutes to complete the Academic Achievement in Science Test. The data thus collected was analyzed statistically.

12. ANALYSIS, INTERPRETATION AND DISCUSSION

Research becomes meaningful in the process of data being collected and interpreted. Proper analysis and interpretation of data facilitates the researcher in drawing out meaningful inferences from the results. The main purpose of the study is to analyze the effects of multiple intelligence instructional strategies on attitude towards Science learning and academic achievement in Science among students.

12.1 Analysis of Variance with regard to the Pre and Post-test Scores of Attitude towards Science Learning and Achievement in Science among Standard IX Students

The analysis of variance commonly referred to by the acronym ANOVA, at its lowest level is essentially an extension of the logic of t-tests to those situations where comparison of means of three or more samples, called independent groups concurrently becomes essential.

The following set of tables (Table-2a and Table-2b) exhibits the analysis of variance among standard IX students experimental and control groups with regard to pre-test scores of attitude towards Science learning.

Table-2a

Statistical Analysis of Means of Pre-test Scores of Attitude towards Science Learning among Standard IX Students in Experimental and Control Groups

Variable	Sample Size	Mean	SD	SEM	SED	CR
Experimental Group	43	40.33	5.58	0.85	0.15	0.14[NS]
Control Group	47	40.17	5.35	0.78		

NS-Not Significant

In Table-2a the mean and standard deviation of pre-test scores of attitude towards Science learning are 40.33 and 5.58 respectively among standard IX students in experimental group and 40.17 and 5.35 respectively among standard IX students in control group. The critical ratio value is 0.14, which is not significant.

It is evident that the standard IX students in experimental and control groups do not differ significantly in their per-test scores of attitude towards Science learning.

Table-2b

Statistical Analysis of Means of Pre-test Scores of Academic Achievement in Science among Standard IX Students in Experimental and Control Groups

Variable	Sample Size	Mean	SD	SEM	SED	CR
Experimental Group	43	22.60	1.64	0.25	0.37	0.66[NS]
Control Group	47	22.85	1.87	0.27		

NS-Not Significant

In Table-2b the mean and standard deviation of pre-test scores of academic achievement in Science are 22.60 and 1.64 respectively among standard IX students in experimental group and 22.85 and 1.87 respectively among standard IX students in control group. The critical ratio value is 0.66, which is not significant.

It is evident that the standard IX students in experimental and control groups do not differ significantly in their per-test scores of academic achievement in Science.

The analysis of variance between the pre-test and post test scores of attitude towards Science learning and academic achievement in Science among standard IX students in experimental and control groups are presented hereunder (Table-3a to Table-4b).

Table-3a

Statistical Analysis of Means of Pre-test and Post-test Scores of Attitude towards Science Learning among Standard IX Students in Experimental Group

Variable	Sample Size	Mean	SD	SEM	SED	CR
Pre-test	43	40.33	5.58	0.85	1.64	9.74**
Post-test	43	56.28	9.18	1.40		

**Significant at 0.01 level

In Table-3a the mean and standard deviation of scores of attitude towards Science learning are 40.33 and 5.58 respectively in the pre-test and 56.28 and 9.18 respectively in the post-test among standard IX students in experimental group. The critical ratio value is 9.74, which is significant.

It is evident that the standard IX students in experimental group are significantly better in their post-test scores compared to their pre-test scores of attitude towards Science learning.

Figure-5

Means of Pre and Post-test Scores of Attitude towards Science Learning among Standard IX Students in Experimental Group

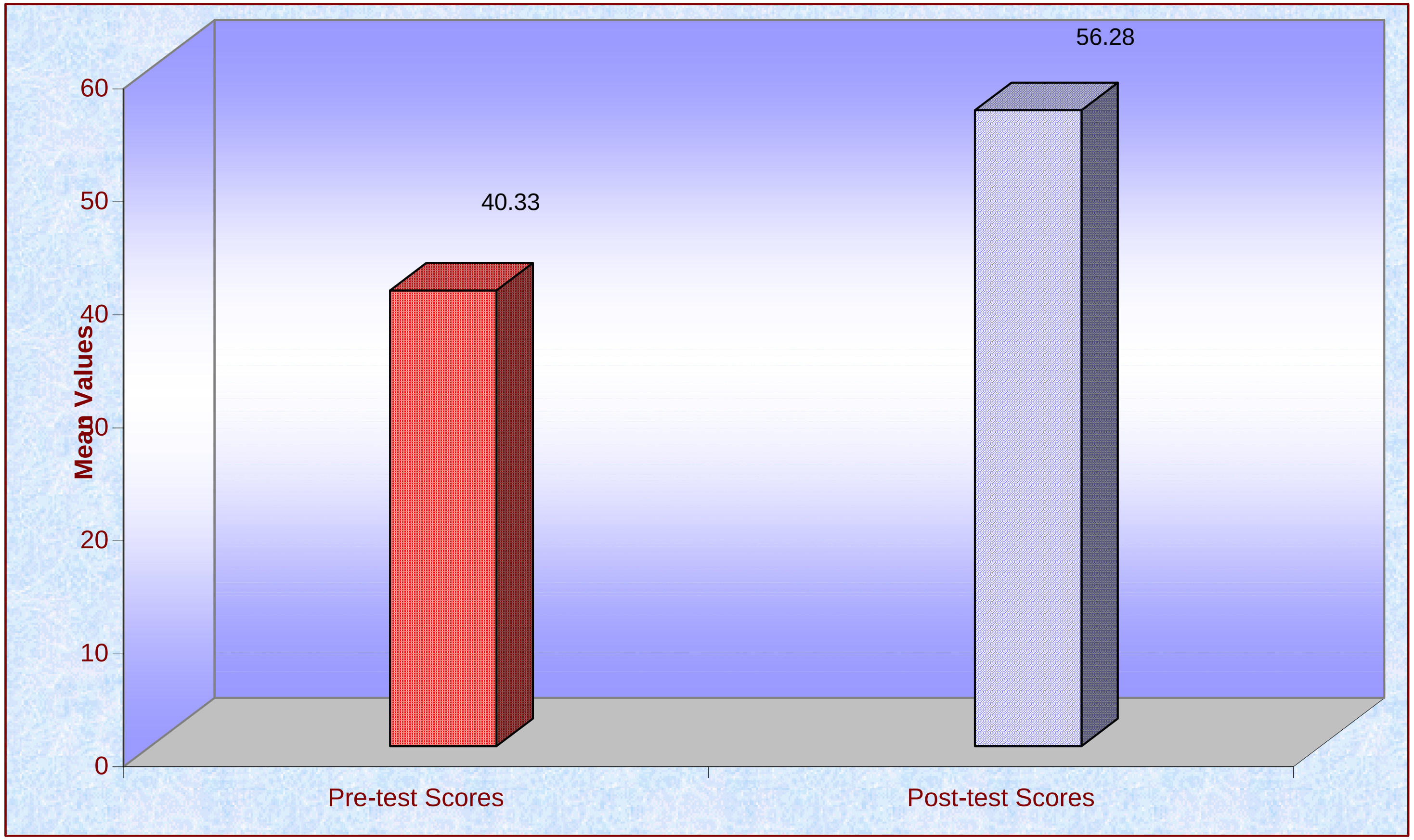


Table-3b

Statistical Analysis of Means of Pre-test and Post-test Scores of Attitude towards Science Learning among Standard IX Students in Control Group

Variable	Sample Size	Mean	SD	SEM	SED	CR
Pre-test	43	40.17	5.35	0.78	1.15	0.63^{NS}
Post-test	43	40.89	5.78	0.84		

NS-Not Significant

In Table-3b the mean and standard deviation of scores of attitude towards Science learning are 40.17 and 5.35 respectively in the pre-test and 40.89 and 5.78 respectively in the post-test among standard IX students in control group. The critical ratio value is 0.63, which is not significant.

It is evident that the standard IX students in control group do not differ significantly in their pre and post-test scores of attitude towards Science learning.

Figure - 6

Means of Pre and Post-test Scores of Attitude towards Science Learning among Standard IX Students in Control Group

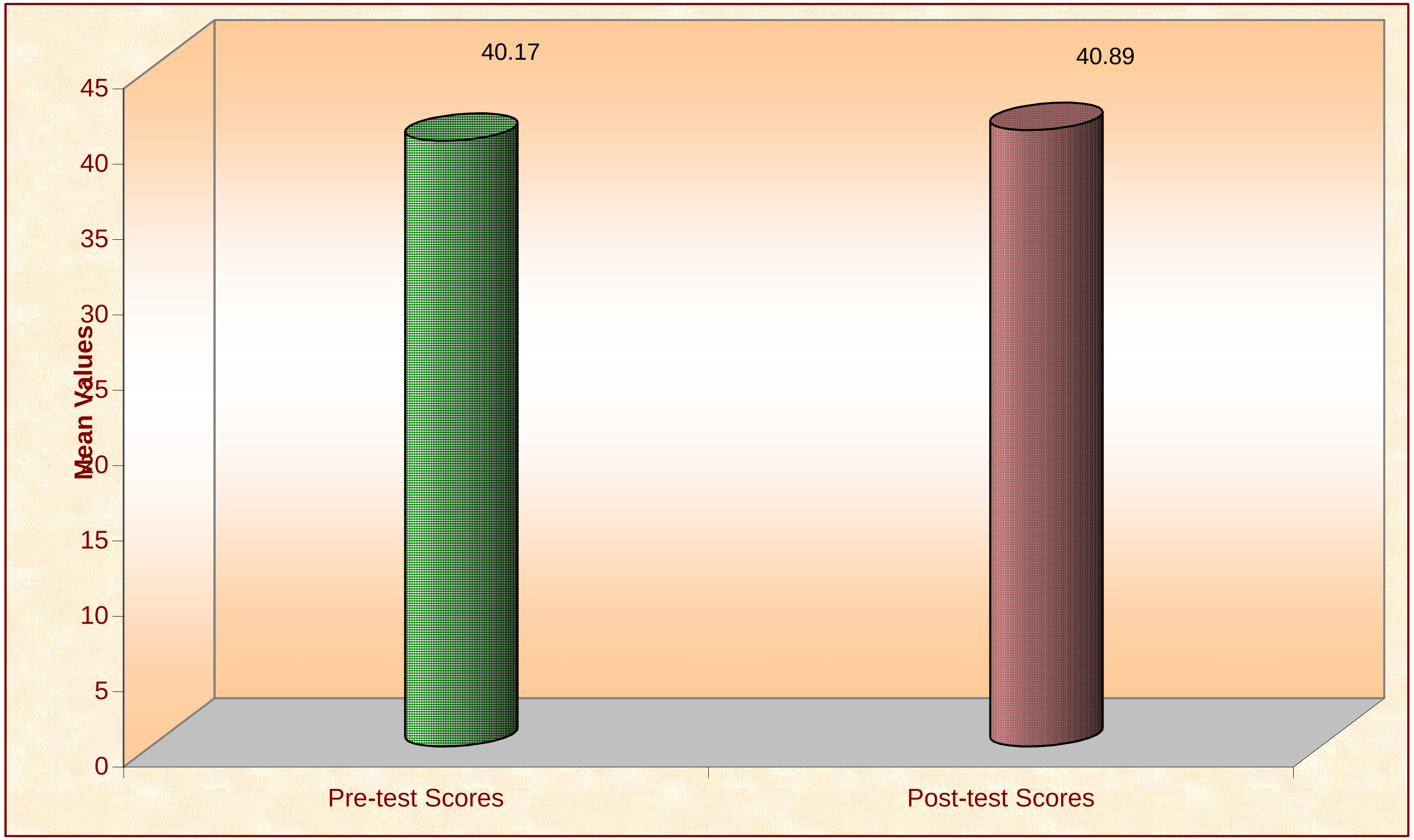


Table - 4a

Statistical Analysis of Means of Pre-test and Post-test Scores of Academic Achievement in Science among Standard IX Students in Experimental Group

Variable	Sample Size	Mean	SD	SEM	SED	CR
Pre-test	47	22.60	1.64	0.25	0.54	19.68**
Post-test	47	33.30	3.17	0.48		

**Significant at 0.01 level

In Table-4a the mean and standard deviation of scores of academic achievement in Science are 22.60 and 1.64 respectively in the pre-test and 33.30 and 3.17 respectively in the post-test among standard IX students in experimental group. The critical ratio value is 19.68, which is significant.

It is evident that the standard IX students in experimental group are significantly better in their post-test scores compared to their pre-test scores of academic achievement in Science.

Figure - 7

Means of Pre and Post-test Scores of Academic Achievement in Science among Standard IX Students in Experimental Group

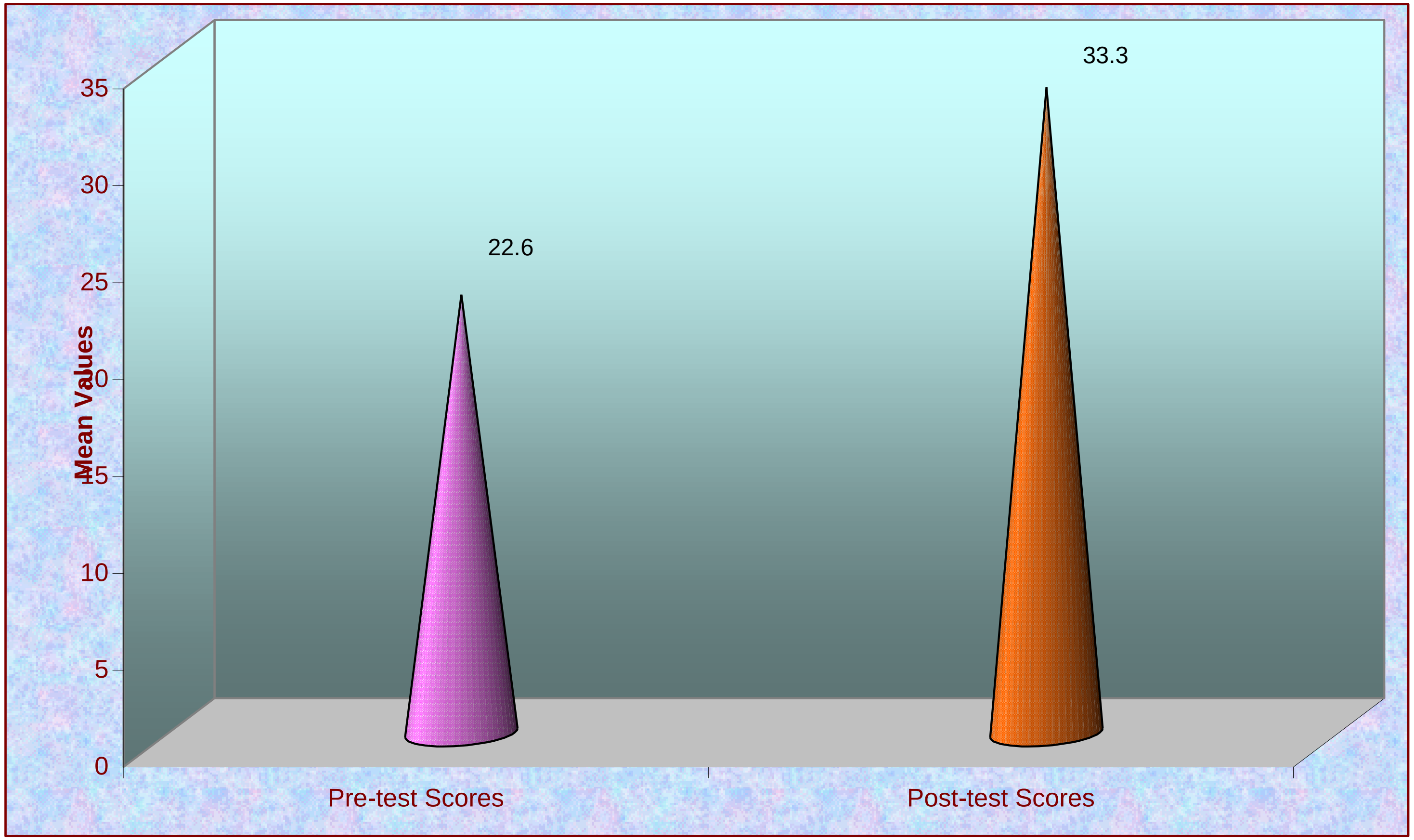


Table - 4b

Statistical Analysis of Means of Pre-test and Post-test Scores of Academic Achievement in Science among Standard IX Students in Control Group

Variable	Sample Size	Mean	SD	SEM	SED	CR
Pre-test	47	22.85	1.87	0.27	0.61	1.49^{NS}
Post-test	47	23.77	3.77	0.55		

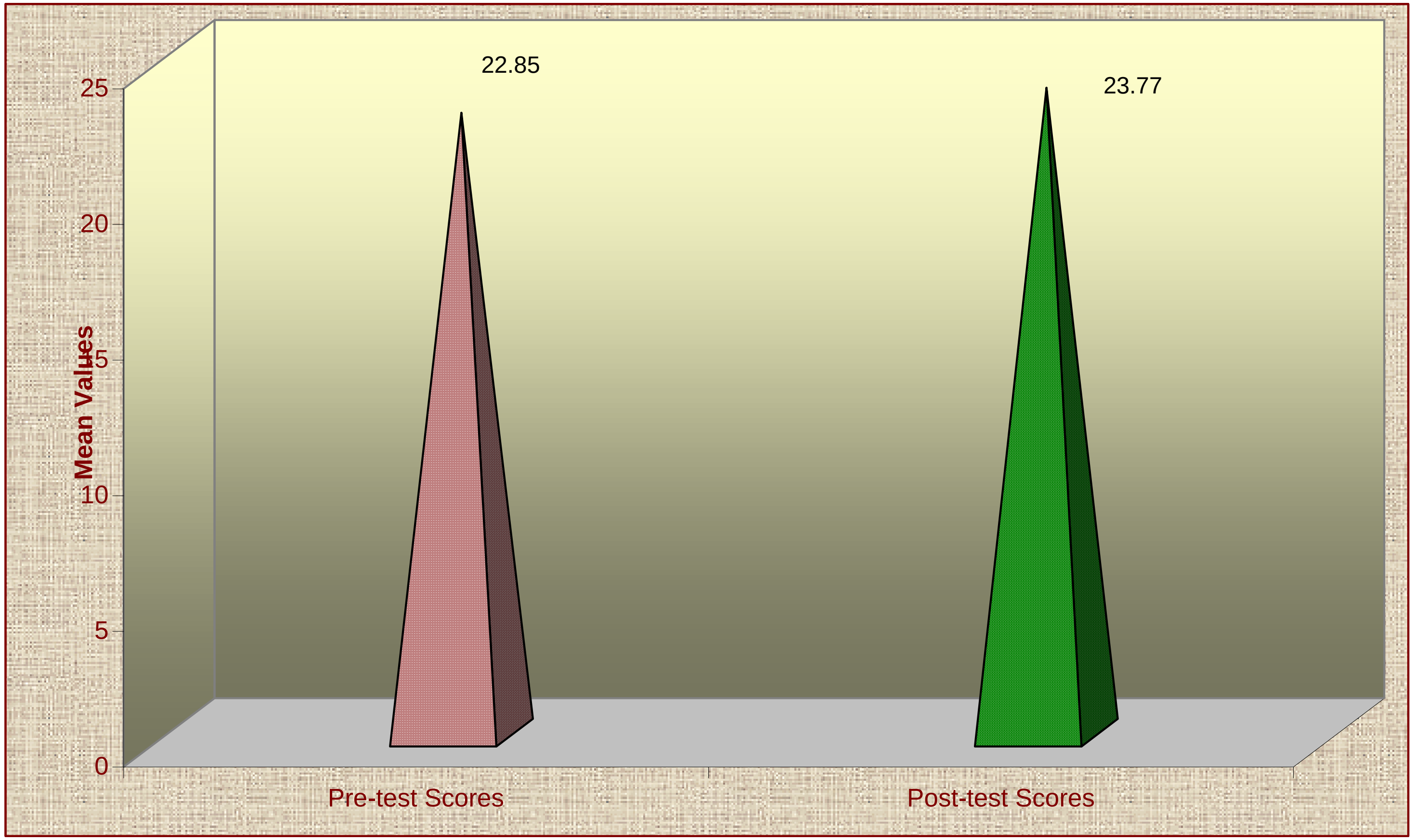
NS-Not Significant

In Table-4b the mean and standard deviation of scores of academic achievement in Science are 22.85 and 1.87 respectively in the pre-test and 23.77 and 3.77 respectively in the post-test among standard IX students in control group. The critical ratio value is 1.49, which is not significant.

It is evident that the standard IX students in control group do not differ significantly in their pre and post-test scores of academic achievement in Science.

Figure - 8

Means of Pre and Post-test Scores of Academic Achievement in Science among Standard IX Students in Control Group



The next set of analyses that investigated the variances among the post-test scores of attitude towards Science learning and academic achievement in Science among standard IX students in experimental and control groups are presented in tables below (Table-5a and Table-5b).

Table - 5a

Statistical Analysis of Means of Post-test Scores of Attitude towards Science Learning among Standard IX Students in Experimental and Control Groups

Variable	Sample Size	Mean	SD	SEM	SED	CR
Experimental Group	43	56.28	9.18	1.40	1.60	9.60**
Control Group	47	40.89	5.78	0.84		

**Significant at 0.01 level

In Table-5a the mean and standard deviation of post-test scores of attitude towards Science learning are 56.28 and 9.18 respectively among standard IX students in experimental group and 40.89 and 5.78 respectively among standard IX students in control group. The critical ratio value is 9.60, which is significant.

It is evident that the students in experimental group are significantly better in the post-test scores of attitude towards Science learning compared to the students in control groups.

Figure - 9

Means of Post-test Scores of Attitude towards Science Learning among Standard IX Students in Experimental and Control Groups

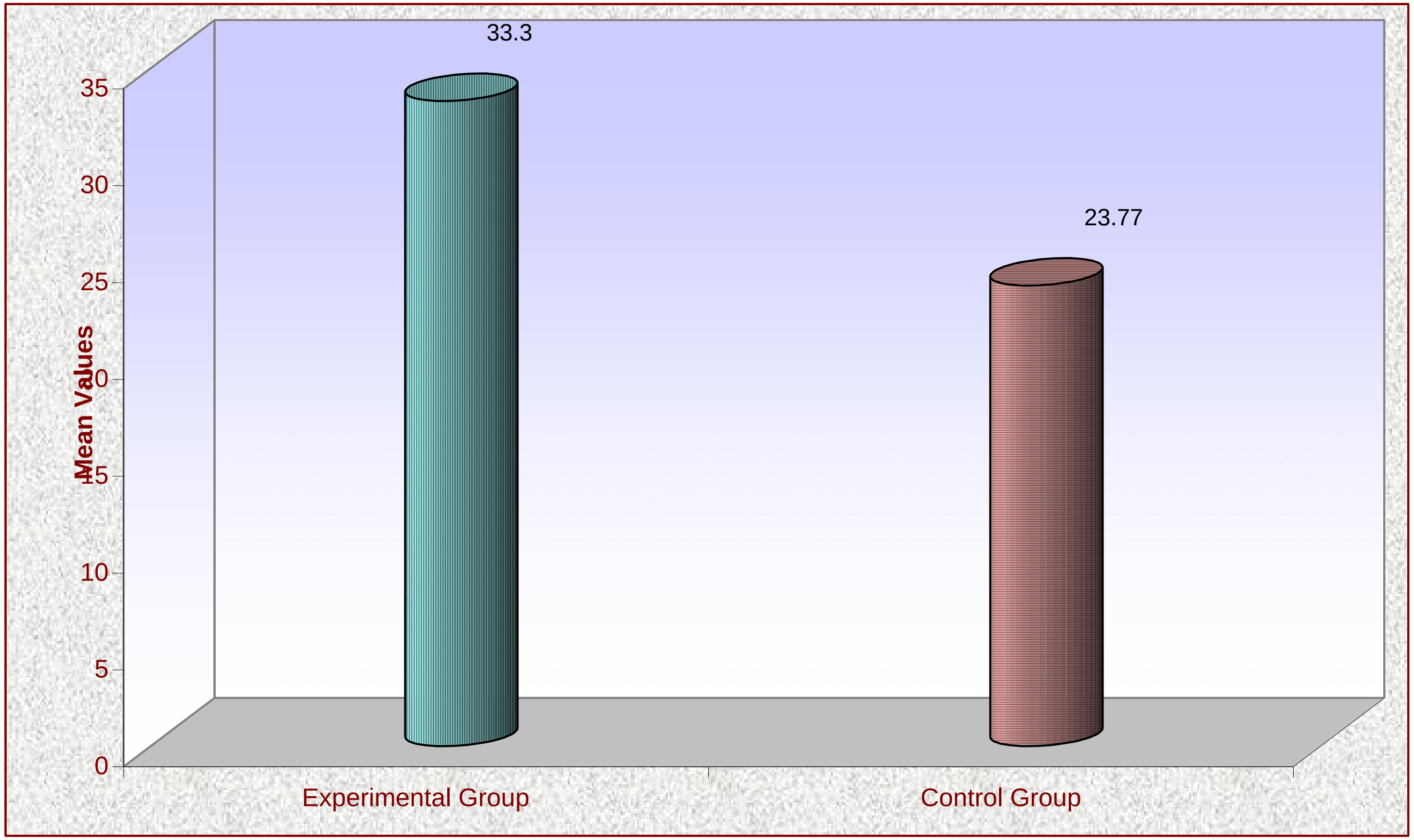


Table - 5b

Statistical Analysis of Means of Post-test Scores of Academic Achievement in Science among Standard IX Students in Experimental and Control Groups

Variable	Sample Size	Mean	SD	SEM	SED	CR
Experimental Group	43	33.30	3.17	0.48	0.74	12.93**
Control Group	47	23.77	3.77	0.55		

**Significant at 0.01 level

In Table-5b the mean and standard deviation of post-test scores of academic achievement in Science are 33.30 and 3.17 respectively among standard IX students in experimental group and 23.77 and 3.77 respectively among standard IX students in control group. The critical ratio value is 12.93, which is significant.

It is evident that the students in experimental group are significantly better in their post-test scores of academic achievement in Science compared to the students in control groups.

Figure - 10

Means of Post-test Scores of Academic Achievement in Science among Standard IX Students in Experimental and Control Groups

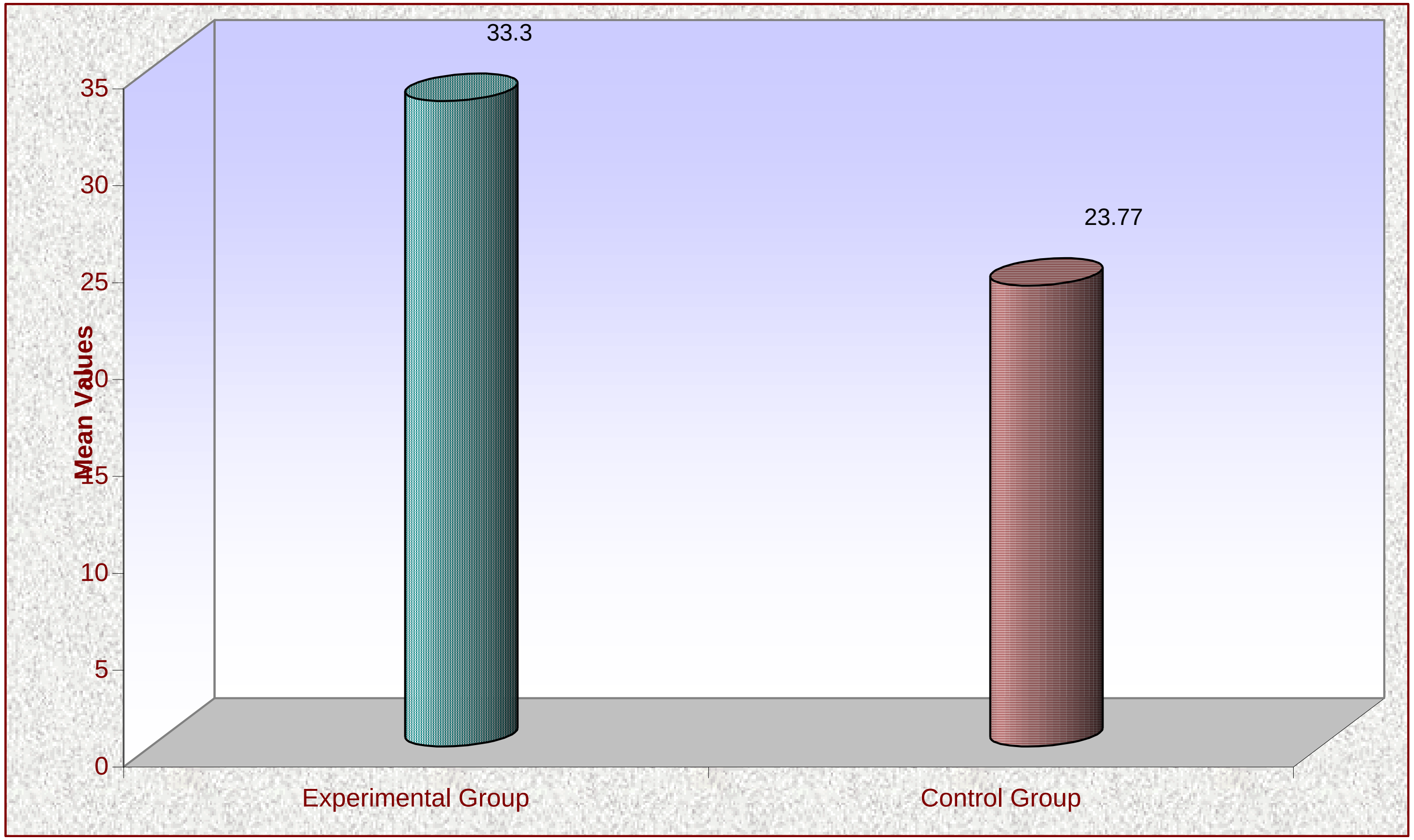


Figure - 11

Pre and Post-test Profile of Standard IX Students in Experimental Group

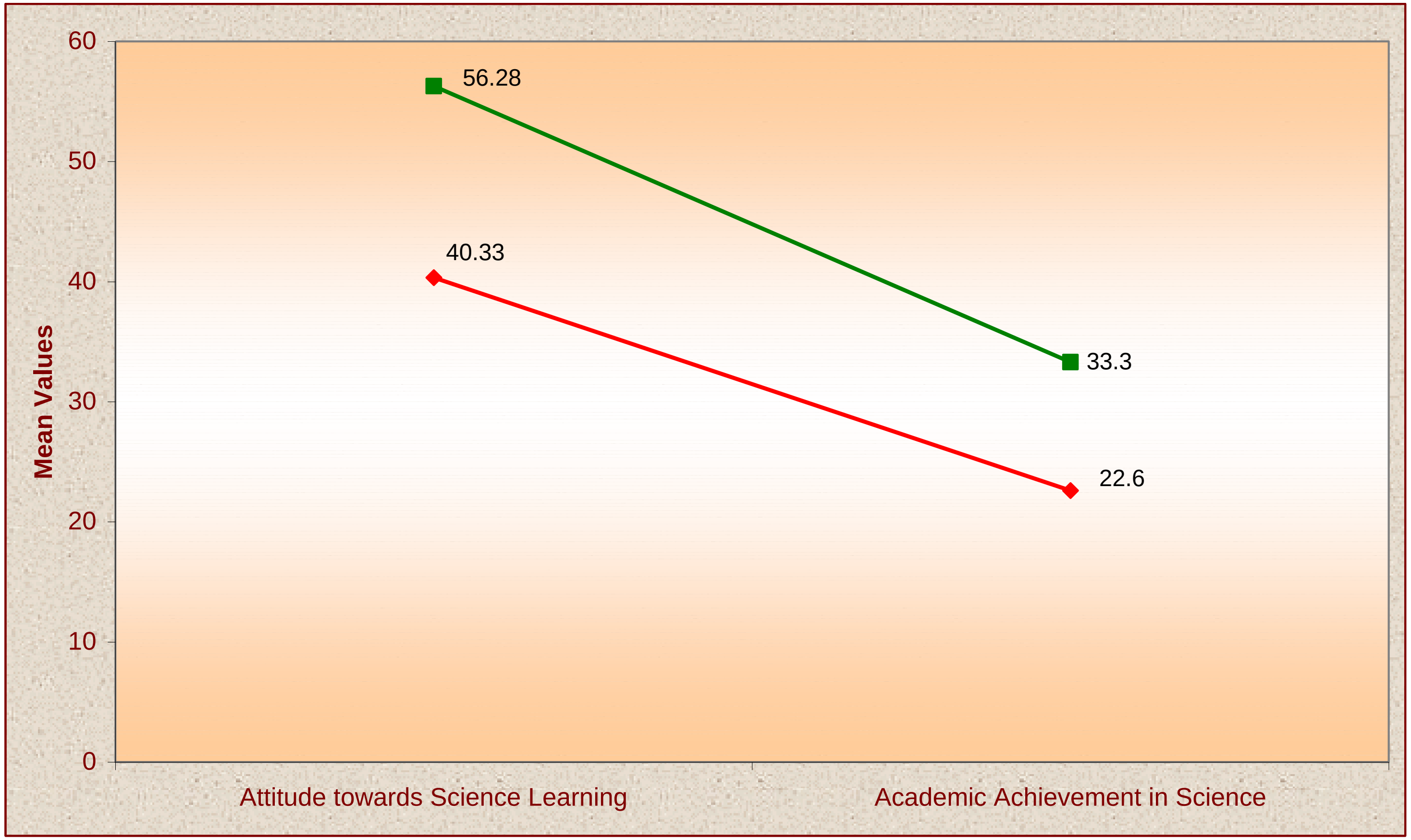
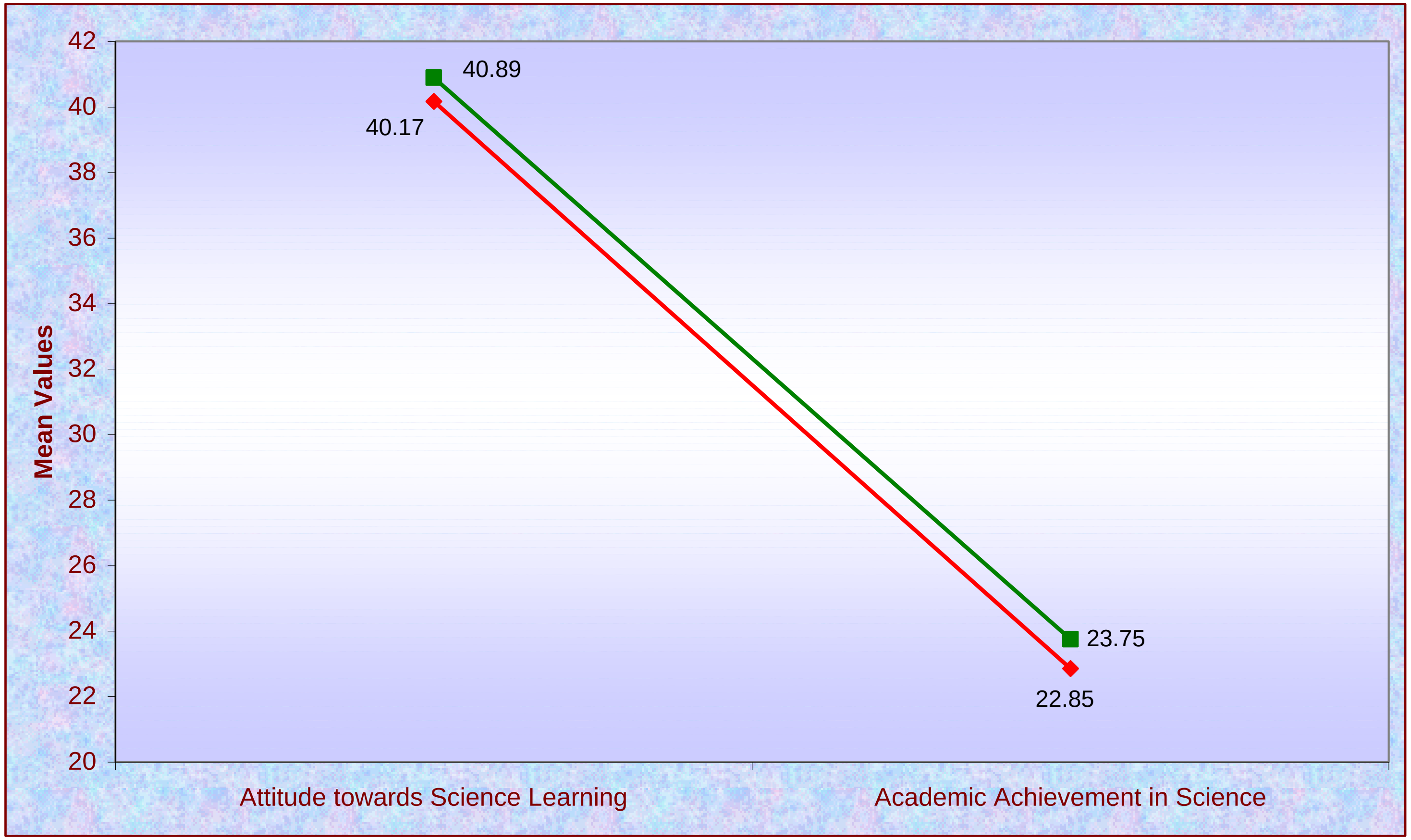


Figure - 12

Pre and Post-test Profile of Standard IX Students in Control Group



12.2 Discussion on the Analysis of Variance with regard to the Pre and Post-test Scores of Attitude towards Science Learning and Achievement in Science among Standard IX Students

Gardner's theory argues that intelligence, particularly as it is traditionally defined, does not sufficiently encompass the wide variety of abilities humans display. In his conception, a child who masters multiplication easily is not necessarily more intelligent *overall* than a child who struggles to do so. The second child may be stronger in another *kind* of intelligence and therefore (i) may best learn the given material through a different approach, (ii) may excel in a field outside of mathematics, or (iii) may even be looking at the multiplication process at a fundamentally deeper level, which can result in a seeming slowness that hides a mathematical intelligence that is potentially higher than that of a child who easily memorizes the multiplication table.

The Multiple Intelligences Theory suggests that no one set of teaching strategies will work best for all students at all times. All children have different proclivities in the seven intelligences, so any particular strategy is likely to be successful with several students, and yet, not for others. Because of these individual differences among students, teachers are best advised to use a broad range of teaching strategies with their students. As long as instructors shift their intelligence emphasis from presentation to presentation, there will always be a time during the period or day when a student has his or her own highly developed intelligence(s) actively involved in learning.

The findings of a study conducted by Harvard's Project Zero, in interviewing the principals of 41 schools using multiple intelligences, 78% of them said that their schools had realized gains on standardized achievement scores and 63% attributed the growth to "practices inspired by Multiple Intelligence Theory. Not surprisingly, the use of MI paid other benefits in these schools as well: 78% of the schools reported improved performances by students having learning difficulties, 80% reported improvement in parent participation, and 81% reported improved student discipline. In the applied quantitative study conducted by Douglas (2008) made a comparison between two distinct instructional methods: Multiple Intelligence (MI) and Direct Instruction (DI). The current research examined how these methods affect the achievement scores in Mathematics. The results suggested that performance on a post Mathematics assessment for students exposed to MI will show a considerable increase when compared to those taught using DI.

The results of the present investigation is in line with the previous researches that have established significant difference in academic performance and attitude towards learning lessons between the students in experimental group, exposed to multiple intelligences supported instructional strategy like, problem based teaching and students in control group (Bagci, and others, 2005; Gultekin, 2005; Ciftci, 2006; Ozdemir, 2006; Kemaloglu, 2006; Cirak, 2006; Chen, 2006; Sylvester, 2007;) and control group students, exposed to traditional instructional method of instruction.

Based on the findings obtained in the present study, it can be said that there is a significant difference between the achievement levels of the students who have been educated by multiple intelligences instruction strategy and the students who have been educated by the traditional instruction methods. The students who have been educated by multiple intelligences instruction strategy have become more successful than the students who have been educated by the traditional instruction methods. Demirel (1998) aimed to investigate the effects of multiple intelligences instruction strategy on university students' learning outcomes. In addition to academic success of the students, he found that multiple intelligences instruction strategy made students happy during the learning process by providing them with rich learning experiences. Similarly, Mettetal and others (1997) aimed to determine effects of multiple intelligences instruction both on students and their parents. In the end of the study, it was seen that students showed higher achievement levels than their peers.

It was reported that when the learning environment had an appropriate design, students' attitudes, and motivation increased. Gurcay and Eryilmaz (2005) studied on students' challenge seeking during multiple intelligences instruction strategy in physics classroom so that it was found out that students in the experimental group which multiple intelligences strategy was applied had more achievement levels than those in the control group. Temur (2007) found out similar findings related to the effects of multiple intelligences instruction strategy in mathematics classrooms in 4th grade so that according to the results students had higher achievement levels and retention levels than the students which traditional instructional methods were applied in the control group. In this regard, in studies carried out by Nyugen (2000), Bumen (2001), Korkmaz (2001), Guler (2004), Guler-Karadeniz (2006), Hamurlu (2007), Johnson (2007), Sengul and Oz (2008) and Douglas and others (2008), it was found out that students in the experimental groups which multiple intelligences instruction strategy was used differed significantly than the students in the control groups which traditional instructional methods were used in the classroom. According to the results of these studies, it can be said that students in the experimental classrooms were more successful academically than their peers in the control groups which traditional instructional methods were applied. The students in the experimental group which multiple intelligences instruction strategy was used had a more achievement level. These results of the stated studies resemble to the result of the present study. It can be said based on the findings; multiple intelligences instruction strategy was more effective on the development of students' academic achievement levels than the traditional instructional methods. On the other hand, as part of multiple intelligences instruction strategy (bodily-kinesthetic and interpersonal intelligences), the dramatization method was used in the experimental process. Ustundağ (1997) found out that students had higher achievement levels in the experimental group which dramatization technique was used than the students in the control group which traditional instructional methods were used.

In terms of attitude towards Science learning, there was a significant difference between the experiment group and the control group. The students who have been educated by multiple intelligences instruction strategy have been found out to have more positive attitude levels to Science lesson than those who have been educated by the traditional instructional methods. Bumen (2001), Korkmaz (2001), Guler (2004), Hamurlu (2007) and Sengul and Oz (2008), carried out studies by multiple intelligences instructional strategy in learning atmospheres. They explored students' attitudes towards lessons by multiple intelligences instruction strategy. In their studies, they found that there was a significant difference in the attitude levels towards the lesson between the groups, which multiple intelligences instruction strategy (experimental group) and the other group for which the traditional instruction methods (control group) were used. The students who were educated by multiple intelligences instruction strategy had developed more positive attitudes towards the lesson than the students who were educated by the traditional instructional methods.

These results resemble to the result of the present study. It can be said based on the findings; multiple intelligences instruction strategy was more effective on the development of students' attitudes towards lesson than the traditional instructional methods. Douglas and others (2008) investigated the effects of multiple intelligences instruction strategy on learning process and learners' attitudes. In their researches, it was found that there was significant difference between pre- and post-test results of attitude scale on control and experimental groups. These results in the stated studies also resemble to the result of the current study.

According to Bas (2010b), students in multiple intelligences instruction atmosphere are exposed to a wide range of skills and competencies such as collaboration, project planning, decision making, critical thinking, drawing, composing, time management, vs. Collaborative learning allows students to bounce ideas off each other, voice their own opinions, and negotiate solutions - all skills that will be necessary in the workplace (Bas, 2009a).

In the present study the analysis of the experimental study has indicated that the experimental group students' achievement level was significantly higher than those taught using traditional instructional methods. The most important thing in research was the experimental group students had more fun when they were learning and they did, touched, saw, and spoke about the things they learnt and they also had the change of socialization and cooperation which are more important for them in these ages. The researcher also sees that multiple intelligences instruction strategy helps the learners to develop many skills like, physical, intellectual, social, emotional and moral skills which are the skills the young learners have to develop. In multiple intelligences instruction strategy, students used different types of intelligences. By this way, students not only had high achievement levels in Science but also they had chance to practise their different skills such as drawing, writing, thinking, composing,

13. MAJOR FINDINGS

MAJOR FINDINGS

From the analysis of the effect of multiple intelligences strategies on attitude towards Science learning and academic achievement in Science among students in a select matriculation board school the following observations have been made.

- Students in experimental and control groups do not differ significantly in their per-test scores of attitude towards Science learning.
- Students in experimental and control groups do not differ significantly in their per-test scores of academic achievement in Science.
- Students in experimental group are significantly better in their post-test scores compared to their pre-test scores of attitude towards Science learning.
- Students in control group do not differ significantly in their pre and post-test scores of attitude towards Science learning.
- Students in experimental group are significantly better in their post-test scores compared to their pre-test scores of academic achievement in Science.
- Students in control group do not differ significantly in their pre and post-test scores of academic achievement in Science.

- Students in experimental group are significantly better in the post-test scores of attitude towards Science learning compared to the students in control groups.

- Students in experimental group are significantly better in their post-test scores of academic achievement in Science compared to the students in control groups.

14. EDUCATIONAL IMPLICATIONS OF THE STUDY

Rather than functioning as a prescribed teaching method, curriculum, or technique, Multiple Intelligences Theory provides a way of understanding intelligence, which teachers can use as a guide for developing classroom activities that address multiple ways of learning and knowing (Christison, 1999b). Teaching strategies informed by Multiple Intelligences Theory can transfer some control from teacher to learners by giving students choices in the ways they will learn and demonstrate their learning.

According to Brookes and Brooks (1999) teachers who operate without awareness of their students' points of view often doom students to dull, irrelevant experiences, and even failure. As Dickinson, Forester, McKenzie, Hoerr, McKenzie, Ribot, Weber and Wilson have demonstrated, the multiple intelligences is a way of providing students with constructive teaching opportunities for all types of learners that will help them reflect and question what they have learned. Through these experiences and acquired knowledge students of all ages will be able to build on that knowledge and implement it accordingly while acquiring more new knowledge; and the cycle of learning never ends.

Accepting Gardner's Theory of Multiple Intelligences has several implications for teachers in terms of classroom instruction. The theory states that all nine intelligences are needed to productively function in society. Teachers, therefore, should think of all intelligences as equally important. This is in great contrast to traditional education systems which typically place a strong emphasis on the development and use of verbal and mathematical intelligences. Thus, the Theory of Multiple Intelligences implies that educators should recognize and teach to a broader range of talents and skills.

Another implication is that teachers should structure the presentation of material in a style which engages most or all of the intelligences. For example, when teaching about the revolutionary war, a teacher can show students battle maps, play revolutionary war songs, organize a role play of the signing of the Declaration of Independence, and have the students read a novel about life during that period. This kind of presentation not only excites students about learning, but it also allows a teacher to reinforce the same material in a variety of ways. By activating a wide assortment of intelligences, teaching in this manner can facilitate a deeper understanding of the subject material.

Everyone is born possessing the nine intelligences. Nevertheless, all students will come into the classroom with different sets of developed intelligences. This means that each child will have his own unique set of intellectual strengths and weaknesses. These sets determine how easy (or difficult) it is for a student to learn information when it is presented in a particular manner. This is commonly referred to as a learning style. Many learning styles can be found within one classroom. Therefore, it is impossible, as well as impractical, for a teacher to accommodate every lesson to all of the learning styles found within the classroom. Nevertheless the teacher can show students how to use their more developed intelligences to assist in the understanding of a subject which normally employs their weaker intelligences (Lazear, 1992). For example, the teacher can suggest that an especially musically intelligent child learn about the revolutionary war by making up a song about what happened.

Catering to the multiple intelligences of students different instructional strategies could be adopted by teachers in the classrooms as follows:

Linguistic intelligence enables one to pay special attention to grammar and vocabulary. They have great ability to use words with clarity. These people can use this to their own benefit either to explain, persuade, or entertain.

In order for teachers to help linguistic learners progress, they need to use language that the student can relate to and fully comprehend. If used correctly, language can provide a bridge between the material and the learner. Having children write, read, and give oral reports about an element in their own lives such as sports, television, or popular bands develops their linguistic intelligence.

Spatial intelligence empowers hunters and travelers-giving them better accuracy and less of a chance of getting lost. A navigator or guide possesses a great deal of this intelligence, as does an architect or lighting designer. People with spatial intelligence often like playing chess, a lot of color, and to imagine the world differently.

Children with spatial intelligence are best taught using pictures or photographs. It is often a good assessment to have them draw their ideas. These students also benefit from films, overheads, diagrams, and other such visuals.

Those with interpersonal intelligences are often found in professions such as teaching, politics, religious leaders such as Gandhi or Martin Luther King Junior, salesmen, skilled parents, therapists, or counselors. Cult leaders and people like Adolf Hitler have been known to have high degrees of interpersonal intelligence, proving that it can also be used for things other than good.

The interpersonal intelligence can be fostered through having students work together. The learning and the use of a culture's symbol system leads to development of interpersonal intelligence. Much of the personal intelligences is basic and does not require much from others. Observation and experience are the most appropriate tools to further these intelligences.

All of the intelligences described are a better way for teachers to understand and accommodate different learning styles. Teachers should structure the presentation of material in a style, which engages all or most of the intelligences. When teachers center lessons on the students' needs, it optimizes learning for the whole class. Teachers who teach towards the multiple intelligences realize the benefits such as active learners and successful students. Each of the intelligences is potential in every learner and it is part of a teacher's job to nurture and help the children develop their own intelligences.

As the education system has stressed the importance of developing mathematical and linguistic intelligences, it often bases student success only on the measured skills in those two intelligences. Supporters of Gardner's Theory of Multiple Intelligences believe that this emphasis is unfair. Children whose musical intelligences are highly developed, for example, may be overlooked for gifted programs or may be placed in a special education class because they do not have the required math or language scores. Teachers must seek to assess their students' learning in ways which will give an accurate overview of their strengths and weaknesses.

As children do not learn in the same way, they cannot be assessed in a uniform fashion. Therefore, it is important that a teacher create an "intelligence profiles" for each student. Knowing how each student learns will allow the teacher to properly assess the child's progress (Lazear, 1992). This individualized evaluation practice will allow a teacher to make more informed decisions on what to teach and how to present information.

Traditional tests (e.g., multiple choice, short answer, essay...) require students to show their knowledge in a predetermined manner. Supporters of Gardner's theory claim that a better approach to assessment is to allow students to explain the material in their own ways using the different intelligences. Preferred assessment methods include student portfolios, independent projects, student journals, and assigning creative tasks. An excellent source for a more in-depth discussion on these different evaluation practices is Lazear (1992).

15. CONCLUSION

At the peak of Psychometric and Behaviorist era, it was commonly believed that intelligence is inherited single entity, and that human beings - initially a blank slate - can be trained to learn anything, provided it was delivered in an appropriate manner, it considers that adults have absolute power to determine the future of children, but never saw that, more important is the child is given the discretion to determine their own future. With the increasing number of results of research on intelligence, found that there are a lot of intelligence, quite independently of one another, each intelligence has different strengths and constraints, which thus has become innate in every child from birth, and that the new hard to apply the things that are contradictory in a domain matching the strength and intelligence (Gardner 1993).

The Multiple Intelligences Theory has confirmed educators in everyday experience: students think and learn in different ways. He also provides educators with a conceptual framework for organizing and reflecting on curriculum assessment and pedagogical practices. On the contrary, this reflection has many educators to develop new approaches that might better meet the needs of different learners in the classroom. According to Wilson (1998) some teachers are attracted to the multiple intelligence way of teaching because students become motivated through “natural talents,” which in turn helps teachers build “self-motivating educational experiences.” The MI method of teaching also encourages teachers to empower the learner through higher order thinking. Wilson also believes that Gardner’s theory helps create a better lesson plan that is diversified and supportive of those students who have a difficult time reaching their level of potential. Similarly as a result of various researches conducted, Foster (2001) emphasized the fact that multiple intelligences help enhance the child’s whole brain and its functioning. The multiple intelligences method of creating the constructive classroom is ideal because it helps remove the teacher centered syndrome, which at times occurs in the classroom and this is what Forester is trying to relay to all teachers.

Although there may be some questions and important issues about the views of Howard Gardner's ideas about multiple intelligences, but somehow he has helped the workings of education. It has helped a large number of educators to encourage them to see not a narrow domain of intelligence, curriculum, and tests. Then from the results of this theory, has come to view children as a great person, who needs to give big awards, not only as a person who is only determined by the absolute adults. Howard Gardner's view of the Theory of Multiple Intelligences has helped educators to reflect on practice, and they provided a basis for expanding their focus and attend to what might help people to live their lives, then at least be considered something that has provided benefits in the educational world order.

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APPENDIX-I

Name:

Group: Experimental Group/ Control Group

TOOL-1

ATTITUDE TOWARD LEARNING OF SCIENCE SCALE

(Grewal, 1972)

Given below are a series of statements that represent your attitude towards learning of Science. Please read the following statements one by one carefully. Each statement can be responded in 5 alternatives viz., Strongly Agree, Agree, Neither Agree nor Disagree, Disagree and Strongly Disagree. According to your view, think and decide which alternative suits you well. Opening upon your decision, put a tick (✓) in front of each statement in the columns provided. There is no time limit, however, do not spend too much time pondering over a single item. I expect an honest response from you as it goes a long way in building research knowledge. Thank you.

S.No.	Items	SA	A	U	D	SD
1	Scientists are persons without human considerations					
2	Scientific careers are more useful to the society than other careers					
3	Study of Science subjects is rather a dull affair					
4	Other subjects cannot be properly understood without the knowledge of Science					
5	Science subjects are very difficult to study					
6	Science subjects are more exact than others					
7	Science is bound to lead our society into godliness					
8	Science subjects provide more relation than other subjects					
9	Scientific knowledge alone cannot improve a man's life					
10	Science sharpens our reasoning power and logical thinking					
11	Science fails to solve all of our problems					
12	Science subjects are useful for getting a success in the competitive examinations					
13	Too much emphasis on Science would bring down our moral standards					

S.No.	Items	SA	A	U	D	SD
14	Science alone is responsible for our technical and industrial progress					
15	A student gets discouraged when he/ she fails to answer certain questions in Science					
16	Working in a scientific field brings more fame					
17	Science can be studied by males only					
18	Science subjects open up many avenues of employment					
19	Science has made us to depend entirely on machines					
20	Science has turned the impossibilities into possibilities					

TOOL-2

SCIENCE TEST

Given below are 50 multiple choice questions pertaining to the topics Force, Work Power and Energy and Sound from your Science text book. Read the questions carefully and tick (√) the correct answer. You are expected to answer all the questions. The duration of the test will be 60 minutes. You are expected to complete the answering all the questions in 50 minutes and check the answers in 10 minutes and then handover the test paper.

1. An object is said to be in motion or at rest with reference to changes in its -----------over time.

   (a) Velocity (b) Position (c) Displacement

2. A spinning top is an example for----------- motion.

   (a) Translational (b) Rotational (C) oscillatory

3. A leaf floating on water is an example for ----------- motion.

   (a) Translational (b) Oscillatory (c) Rotational

4. The rate of change of velocity is -----------.

   (a) Displacement (b) Acceleration (c) Speed

5. When a body is thrown upwards its velocity ------------.

   (a) Increases (b) Decreases (c) Remains the same

6. The acceleration due to gravity near the earth surface is ----------.

   (a) $9.81 ms^{-2}$ (b) $9.78\ ms^{-2}$ (c) $9.88\ ms^{-2}$

7. The velocity of a vehicle increases from $20\ ms^{-1}$ to $50\ ms^{-1}$ in 10 s. Its acceleration is ------------.

   (a) $30\ ms^{-2}$ (b) $3 ms^{-2}$ (c) $15\ ms^{-2}$

8. The slope of displacement time curve represents the ------------- of an object.

(a) Speed (b) Velocity (c) Acceleration

9. The motion of a freely falling body is an example for ------------- acceleration.

(a) Uniform (b) Non uniform (c) Instantaneous

10. ------------ is a scalar quantity.

(a) Speed (b) Velocity (c) Acceleration

11. ----------- is a vector quantity.

(a) Force (b) Mass (c) Density

12. A student takes 10 minutes to go his school and returns 20 minutes at a distance of 5 km What is his average speed?

(a) 2 km/hr (b) 20 km/hr (c) 200 km/hr

13. The unit of velocity is ---------------.

(a) ms^{-1} (b) ms^{-2} (c) m

14. Quantities specified by magnitudes only are called ---------.

(a) Scalar (b) Vector (c) None of these

15. The motion of a bullet fixed from a rifle is ----------.

(a) Rotational motion (b) Vibrational motion

(c) Translatory motion

16. Negative slope of v-t graph is called ----------.

(a) Positive acceleration (b) Negative acceleration

(c) Negative velocity

17. The distance travelled by an object in one second is called -----------.

(a) Speed (b) Force (c) Velocity

18. The product of mass and -------------- of a body is called momentum.

(a) Velocity (b) Acceleration (c) Force

19. When a force 1 N acts on a mass of 1 kg the object moves with the ----------.
(a) Acceleration of $1ms^{-2}$ (b) Speed of $1ms^{-1}$
(c) Acceleration of 10 ms^{-2}

20. Pick out the wrong statement for a body getting accelerated when it -----------.
(a) Falls towards the earth
(b) Velocity along its straight line remains constant.
(c) Velocity always increases

21. If A and B or two objects with masses 6 kg and 34 kg respectively, then ------.
(a) A has more inertia than B
(b) A and B have the same inertia
(c) B has more inertia than A

22. Inertia depends upon ---------------------.
(a) Mass of the body (b) Shape of the body
(c) Velocity of the body

23. According to the laws of simple pendulum, T= -----------.
(a) $\frac{1}{2}\pi\sqrt{l/g}$ (b) $2\pi\sqrt{l/g}$ (c) $2\pi\sqrt{g/l}$

24. The unit of impulse is -------------.
(a) NS^{-1} (b) NS^{-2} (c) NS

25. Period of oscillation of a seconds pendulum is ----------------.
(a) 2s (b) 1s (c) 0.2s

26. The maximum displacement of the simple pendulum bob from the mean position is -------------.
(a) Amplitude (b) Wavelength (c) Frequency

27. Action and reaction do not balance each other because they -----------.
(a) Act on the same body (b) Act on different bodies
(c) Are equal

28. -------------- is used to measure the weight of the body.
(a) Physical balance (b) Spring balance
(c) None of these

29. Weight is maximum in the ----------- region.
(a) Polar (b) Equatorial (c) Artic

30. Unit of moment of force is ----------------.
(a) Nm (b) Ns (c) N

31. The definition of force is obtained from ------------- law.
(a) Newton's First (b) Newton's Second
(c) Newton's Third

32. Calculate the acceleration produced by a force of SN exerted on an object of mass 10 kg?
(a) $50ms^{-2}$ (b) $5ms^{-2}$ (c) $0.5\ ms^{-2}$

33. ------------ of an object remains the same.
(a) Weight (b) Mass (c) Force

34. ------------ law is applicable to bodies both at rest and in motion.
(a) Newton's Third (b) Newton's First
(c) Newton's Second

35. The negatively charged particle, electron was discovered by -----------.
(a) J.J Thomson (b) Crooke (c) Bohr

36. Which one of the following is not true about cathode rays --------------.
(a) They are travel in straight line
(b) Positively charged particles
(c) they are made up of particles

37. -------------- discovered the positively charged proton.
(a) J.J. Thomson (b) Bohr (c) Goldstein

38. ----------- discovered neutron.
(a) John Dalton (b) Chadwick (c) Bohr

39. The mass of an electron is -----------.
(a) 9.08×10^{-31} kg (b) 9.88×10^{-31} kg
(c) 0.988×10^{-31} kg

40. ------------- model fail to explain the stability of atoms.
(a) Bohr (b) Rutherford (c) Dalton

41. -------------- of an element are the atoms of the element with the same atomic member best different mass – numbers.

(a) Isotope (b) Isobar (c) Isotones

42. The integral multiples of ------------.

(a) 2π/h (b) h/2π (c) Nh/2π

43. The atomic number of sodium atom is --------------.

(a) 11 (b) 21 (c) 13

44. -------------- is defined as the combining capacity of an element.

(a) Valency (b) Atomic Number

(c) Mass Number

45. The atomic number of an element is equal to the number of ----------- in its nucleus.

(a) Electrons (b) Protons and neutrons

(c) Protons and electrons

46 . ----------- atom model failed in view of electro magnetic theory.

(a) Rutherford (b) Chadwick (c) Bohr

47. The electrical charge of proton is ------------.

(a) 0 (b) +1 (c) -1

48. The charge of an electron is ---------------.

(a) 1.60×10^{-19} coloumb (b) 1.602×10^{-34} coloumb

(c) 16.02×10^{-9} coloumb

49. The mass of a neutron is nearly equal to the mass of a ------------.

(a) Proton (b) Electron (c) Nucleon

50. ----------- received the first atoms for peace award in 1957.

(a) Rutherford (b) Neil Bohr (c) J.J. Thomson

APPENDIX-II

LESSON PLAN

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
1	Force and Motion	Pull or Push of an object is called Force. An object which changes its position with respect to time is called Motion.	The Teacher pushed the table and defined pull or push of an object as force. (Bodily Kinesthetic)	Define Force and Motion.
	Rest	An object which does not change its position with respect to time is called Rest.	The teacher called two students and asked one student to sit and another student to walk. (Bodily Kinesthetic) and explained the definitions of rest and motion. When an object changes its position with respect to time and is called motion and when it does not change its position. It is called rest (Logical Mathematical).	What is Rest?
	Types of Motion	Motion can be classified into (1) Random Motion (2) Translational Motion (3) Rotational Motion (4) Oscillatory Motion	The teacher discussed the different types of motion by showing the flash cards (Spatial Visual). The teacher gave illustrations for different types of motion by showing flash cards. (Spatial Visual)	What are the different types of motion?
	Random Motion	If the object rotates in all directions, it is called random motion.	The motion of a football is an example for Random Motion (Spatial Visual)	What is Random Motion? Give an example.
	Translation Motion	If the path of an object is a straight line or curved line, then it is called translational motion.	Bullet fired from gun is an example for translational motion. (Spatial Visual)	What is translational motion? Give an example.
	Rotational Motion	If the object rotates about an axis then the motion is called Rotational Motion.	The earth orbiting the sun, or rotation of a fan is an example for Rotational Motion. (Spatial Visual)	What is Rotational Motion? Give an example.

<table>
<tr><th>Lesson No.</th><th>Concept</th><th colspan="2">Content</th><th>Instructional Strategy</th><th>Evaluation</th></tr>
<tr><td></td><td>Oscillatory Motion</td><td colspan="2">If the object moves to and fro about a fixed point it is called Oscillatory Motion.</td><td>The motion of a pendulum of a clock is an example for Oscillatory motion. Thus the teacher explained the types of motion citing suitable examples by showing flash cards. (Spatial Visual)</td><td>What is Oscillatory Motion? Give an example.</td></tr>
<tr><td rowspan="3">2</td><td>Scalars and Vectors</td><td colspan="2">Quantities that require only magnitudes to specify them are called Scalar Quantities. Mass, Length, time, temperature, angle, area, volume, density and work are Scalar Quantities.
Quantities that require both magnitude and direction to specify them are called Vector quantities. Momentum, force, velocity, acceleration energy are Vector quantities.</td><td>Teacher defined the definitions of scalar and vector quantities by showing the flashcards (Spatial Visual) and gave different examples.
Teacher demonstrated how mass is a scalar quantity and weight is a vector quantity by using physical balance and spring balance (Bodily Kinesthetic)</td><td>Define Scalar Quantity.</td></tr>
<tr><td></td><td><u>Distance</u></td><td><u>Displacement</u></td><td></td><td></td></tr>
<tr><td></td><td>1 Length of the actual path travelled by a body.

2.It is a scalar.

3.Depends on the path.

4.S = vt

Distance= speed × time</td><td>Length of the straight line path between two points.

It is a vector
Does not depend on the path and depends on the initial and final positions of a body
$\vec{S} = \vec{v}t$
Displacement= Velocity × time</td><td>Teacher thus explained the differences between distance and displacement by showing the chart (Spatial-Visual)</td><td>State the differences between distance and displacement.</td></tr>
</table>

<table>
<tr><th>Lesson No.</th><th>Concept</th><th colspan="2">Content</th><th>Instructional Strategy</th><th>Evaluation</th></tr>
<tr><td rowspan="2">3</td><td>Speed and Velocity</td><td colspan="2">Speed is the distance traveled by an object in one second.

$\text{Speed} = \frac{\text{Distance traveled}}{\text{Time}}$
The displacement of an object in one second is called velocity. Its unit is ms^{-1}.
$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$</td><td>The teacher explained velocity by showing the flashcards (Spatial Visual)</td><td>Define speed.

What is meant by velocity?</td></tr>
<tr><td>Problem</td><td colspan="2">Let a car travel through a continuous road of 1200 km in 20 hours. The displacement of the car towards east is 800 km.

So, average velocity, $V = \frac{800}{20}$
$= 40$ km

Average Speed of car $= \frac{1200}{20}$
$= 60$ km</td><td>The teacher explained how to calculate speed and velocity with the help of blackboard (Logical – Mathematical)</td><td>A student takes 10 minutes to go to his school at a distance of 5 km from his house and takes 20 minutes for the return journey. Calculate his average speed?</td></tr>
<tr><td rowspan="2"></td><td></td><td>Speed</td><td>Velocity</td><td></td><td></td></tr>
<tr><td></td><td>It is the distance traveled by an object in one second
$\text{Speed} = \frac{\text{Distance traveled}}{\text{Time}}$
It is a scalar.

It does not have a direction.</td><td>It is the displacement of an object in one second

$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$
It is a vector.

It has the direction of the displacement.</td><td>The teacher stated the differences between speed and velocity with the help of chart.
(Spatial Visual)</td><td>State the difference between speed and velocity.</td></tr>
</table>

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
4	Acceleration	The change in velocity of an object per unit time is called acceleration. Its unit is ms^{-2}. It is a vector quantity. Acceleration= $\frac{\text{Change in velocity}}{\text{Time}}$	The teacher defines the definition of acceleration and its unit with the help of chart.(Spatial Visual)	Define Acceleration. What is the unit of Acceleration?
		An object moving with a uniform speed in a circular path has an acceleration directed towards the centre of the circular path. This is called Centripetal Acceleration.	Teacher explained the definition of centripetal acceleration with the help of examples. (Spatial Visual)	Define Centripetal Acceleration.
		Equations of motion for uniformly accelerated bodies: Let the initial velocity of an object be u ms^{-1} and final velocity v ms^{-1} after time t. Let a be the uniform acceleration and s, the displacement of the object. Acceleration=$\frac{\text{Change in velocity}}{\text{time}}$ $a = \frac{v - u}{t}$ $at = v - u$ $v = u + at \quad \rightarrow (1)$ Average velocity in time (t), t= $\frac{\text{Distance travelled}}{\text{time}}$ $\frac{u + v}{2} = \frac{s}{t}$ Using equation (1),	Teacher explained the problem with the help of black board .(Logical Mathematical)	What is the average velocity at time t?

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
		$S = (u + u + at)\frac{t}{2}$ $S = (2u + at)\frac{t}{2}$ $S = ut + \frac{1}{2}at^2 \quad \rightarrow(2)$ From equation (1) $v = u + at$ $v - u = at$ $t = \frac{v - u}{a}$ But average velocity $\frac{u + v}{2} = \frac{s}{t}$ $S = \frac{(u + v)}{2} t$ Substituting for t, $S = \frac{(u + v)}{2} \times \frac{(v + u)}{a}$ $= \frac{v^2 - u^2}{2a}$ $2as = v^2 - u^2$ $V^2 = u^2 + 2as$ These are the equations of motion of uniformly accelerated bodies.	Teacher derived the equations of motion by using blackboard and Chart. (Logical Mathematical)	Derive the equations of motion.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
5	Equations of motion for freely falling bodies	All objects are attracted to the centre of the uniform acceleration due to earth's gravitational force. This acceleration of an object due to the gravitational force of attraction is called acceleration due to gravity. The motion of a freely falling body is an ideal example for uniform accelerated motion. The acceleration due to gravity at or near the earth's surface is 9.91 ms $^{-2}$.The acceleration due to gravity on the surface of the moon is 1.6 ms^{-2} and near the surface of the sun is 274 ms^{-2}. For a freely falling body, the initial velocity, u = 0 Let the acceleration a = g and the distance of free fall s = h v = u + at v = 0 + gt v = gt → (1) s = ut + ½ at^2 h = 0 + ½ gt^2 h = ½ gt^2 → (2) v^2 = u^2 + 2as v^2 = 0 + 2gh v^2 = 2gh → (3) From equation (2), it is seen that objects of different masses, released simultaneously from the same height, fall on the ground at the same time with the same velocity. An object thrown vertically upwards, against the force of gravity, has negative acceleration. a = - g.	Teacher derived the equations of motion for freely falling bodies on the blackboard. (Logical Mathematical) Teacher demonstrates by using a ball (Bodily Kinesthetic). When a teacher throws a ball in the upward direction, the ball moves up a certain distance and falls back to the ground.	Derive the expression for motion of freely falling bodies.
	Uniform and Non-uniform motion	An object moving with a constant velocity is said to be in Uniform Motion. An object which does not move with a constant velocity is said to be in Non-uniform Motion.	The teacher explained uniform motion with the help of the graph. (Logical Mathematical) The teacher explained non uniform motion with the help of the graph. (Logical Mathematical)	Define uniform motion. Define non uniform motion.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
	Problem	A car gets accelerated from rest to 2 ms^{-2} .in 10 sec. Calculate the final velocity and the distance traveled by the car.	The teacher explained the calculations with the help of black board. (Logical Mathematical)	A driver applies brake to stop a train moving at a speed of 72 km/hour. The velocity decreases to 36 km/hour as the train moves 200 mt. Find the acceleration of the train.
	Problem	A ball is thrown upward with an initial velocity 15ms^{-1}" and is caught by the person who threw it. Calculate the maximum height reached, the velocity at the time of catch and the time of flight of the ball.	The teacher explained the calculations with the help of black board (Logical Mathematical)	Calculate and tabulate the position and velocity of a freely falling body in 1st 4 seconds.
6	Force	Push or pull of an object is called Force. Force is a vector quantity. The force can alter the speed of the moving object. The force can change the direction of motion of a body. The force applied can change the shape of an object.	The teacher pushed the table and defined pull or push of an object as Force. (Bodily Kinesthetic) The teacher called two students and asked one to kick a foot ball and ask another to stop the ball so that speed of the ball decreases (Bodily Kinesthetic) The teacher explained with an example football. (linguistic) The teacher demonstrated by stretching a rubber band so that, its shape gets changed.	Define force. The force can alter the ------, ----- and ------ of the body.
7	Newton's First Law of Motion	Every body continues in its state of rest or of uniform motion in a straight line unless it is compelled by an external force to change that state.	The teacher placed a book on the table and explained that the book continues to remain there, till a force is applied and then she applied a force so that the book moved from that place. (Bodily Kinesthetic)	State Newton's First Law of motion.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
8	Inertia	The inability of the body to change by itself its state of rest or of uniform motion along a straight line is called Inertia.	The teacher explained the definition of Inertia. (Linguistic)	State the Law of Inertia.
	Inertia of rest	The tendency of an object to remain in its state of rest is called Inertia of Rest.	The teacher demonstrated by placing a coin on a card board placed over a tumbler. She flipped the card quickly and the coin dropped into the tumbler and the card flew off. (Bodily Kinesthetic)	Explain Inertia of Rest.
	Inertia of direction	The tendency of a body to continue to move along a straight path is called Inertia of Direction.	The teacher explained that Inertia of direction happens while traveling in a bus.	Explain Inertia of Direction.
9	Momentum	The product of the mass and velocity of a body is called momentum. Momentum P = mv Unit of momentum is $Kgms^{-1}$. Momentum is a vector quantity.	The teacher demonstrated by throwing a rubber ball and iron ball. She applied greater force to stop the iron ball and a lesser force to stop the rubber ball. This shows that the force required to stop a moving body is directly proportional to its mass 'm' and its inner velocity v. (Linguistic / Bodily Kinesthetic)	Define momentum of a body. Give the unit of momentum.
10	Impulse	Impulse is defined as the product of the force F and the time of contact Δt. ` mv = F Δt	The teacher asked one student to catch the ball with rigid hands. It was seen that in a shorter time the ball hit his hands with a violent force but when the teacher asked the student to move his hands backward by catching the ball, he found that the force is reduced as the time of contact is increased. (Bodily Kinesthetic /Interpersonal)	Explain how Impulse is calculated.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
11	Newton's Second Law of Motion	Rate of change of momentum of a body is directly proportional to the force and takes place in the direction of the force. Consider a body of mass m, whose velocity changes from u to v in time t. Let the magnitude of initial and final momentum of the body be P_1. and P_2. $F \alpha \frac{P_2 - P_1}{t}$ $F = K \frac{(P_2 - P_1)}{t}$ K is the constant of proportionality $F = K \frac{(mv - mu)}{t}$ $\frac{(v - u)}{t}$ is the Magnitude of the rate of change of velocity – which is acceleration a F = kma K = 1 ` F = ma	The teacher explained the Second Law of Motion by using flash cards. (Spatial Visual) The teacher explained the equation with help of black board (Logical Mathematical)	State Newton's Second Law of Motion. Derive the relation F = ma
	Problem	Calculate the acceleration produced when a force of 5 N is exerted on an object of mass 10 kg.	The teacher explained the calculations with the help of blackboard. (Logical Mathematical)	What force would be needed to produce an acceleration of 1 ms^{-2} on a ball of mass 1 kg?

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
12	Mass and weight	The mass of a body is a measure of its inertia. Its unit is kg. It is a scalar quantity. Mass of an object remains the same everywhere in the universe.	The teacher demonstrated by using a beam balance to measure the mass. (Bodily Kinesthetic)	Define mass. Give the unit of mass.
		The weight of a body is the gravitational force of attraction on the body. Its unit is Newton. It is a vector quantity.	The teacher asked the student to find the weight of an object with the help of spring balance. (Interpersonal / Intrapersonal)	Define weight. Give the unit of weight.
	Newton's Third Law of Motion	To every action, there is always an equal and opposite reaction.	The teacher rhymingly defined the law (Musical) The teacher asked one student to blow a balloon and then released it suddenly by keeping the mouth of balloon downward. She explained that the air rushing out vertically downwards is the action and the balloon moving upwards in a direction opposite to that of air is the reaction. (Interpersonal / Bodily Kinesthetic)	State Newton's third law of motion.
13	Periodic Motion	A motion of an object which repeats itself regularly after fixed intervals of time is called Periodic Motion.	The teacher explained the definition by showing the pendulum of a clock. (Bodily kinesthetic)	Define Periodic Motion.
	Simple Harmonic Motion	It is defined as the oscillatory or vibratory motion in which the restoring force acting on a vibrating body is directly proportional to its displacement from the mean position and directed against it.	The teacher explained the definition of Simple Harmonic Motion by using a Simple Pendulum.	Define Simple Harmonic Motion.
	Simple Pendulum	Simple pendulum consists of a heavy bob, suspended by a light inextensible string from a rigid support. The simple pendulum consists of a metallic bob B tied to a thread T and suspended from a rigid support A. It is made to oscillate through a small angle.	The teacher demonstrated the motion of a simple pendulum by moving the bob to one side and allowing it to swing to and fro. (Linguistic / Bodily Kinesthetic)	Explain the working of a simple pendulum.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
	Laws of simple pendulum Acceleration due to gravity	The time period of a simple pendulum is independent of the material and mass of the bob. The time period is independent of the amplitude of oscillation. The time period is directly proportional to the square root of the length of the pendulum. $T \alpha \sqrt{l}$ The time period is inversely proportional to the square root of the acceleration due to gravity $T \alpha \frac{1}{\sqrt{g}}$ Acceleration due to gravity $g = \frac{4\pi^2 \ell}{T^2}$ (By using the laws of simple pendulum)	The teacher asked the students to calculate the time period for different materials and masses of the bob. (Bodily Kinesthetic / Intrapersonal/ Interpersonal) The teacher also asked the students to oscillate the simple pendulum at different angles and explained that the time period does not depend on amplitude. (Intrapersonal / Interpersonal/ Bodily Kinesthetic) The teacher asked the student to calculate the time period for different lengths (Logical Mathematical) The teacher explained acceleration due to gravity at different places. (Linguistic) The teacher explained with the help of black board. (Logical / Mathematical)	As amplitude of oscillation changes, what will happen to the time period? Give the relation between time period and length of the pendulum. How will you determine the acceleration due to gravity (g) using a simple pendulum
14	Like Parallel Forces	If two parallel forces act in the same direction, they are known as like parallel forces.	The teacher explained the definition by using flash cards (Spatial/Visual)	Define Like Parallel Forces.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
	Resultant of like parallel forces	The resultant R of two like parallel forces P and Q acting at points A and B is in magnitude, equal to their sum R=(P&Q) and in direction, the same as P or Q. The position of the resultant at a point C between A and B such that P X AC = Q x BC.	The teacher explained the resultant of Like Parallel Forces using black board. (Logical/Mathematical)	Calculate the resultant of two Like Parallel Forces.
	Unlike Parallel Forces	If two parallel forces act in the opposite direction they are known as Unlike Parallel Forces.	The teacher explained the definition by using flash cards. (Spatial/ Visual)	Define Unlike Parallel Forces.
	Resultant of unlike parallel forces	The resultants of unlike parallel forces is in magnitude, equal to their difference R = P-Q or R=Q-P and in the direction of the greater force at a point C outside AB on the side of the greater force such that P x AC = Q X BC.	The teacher explained the resultant of Unlike Parallel Forces using black board. (Logical Mathematical/Linguistic)	Calculate the resultant of two Unlike Parallel Forces.
	Couple	Two equal and Unlike Parallel Forces not acting at a point constitute a couple.	The teacher explained by using a bottle cap. (Bodily/Linguistic)	How is a Couple formed?
15	Principle of Moments	The Principle of Moments states that if a body is in equilibrium under the action of a number of parallel forces, the sum of the anti clockwise moments about any point must be equal to the sum of the clockwise moments about the same point.	The teacher stated the Principle of Moments by using blackboard. (Logical Mathematical)	State the Principle of Moments.
		According to the Principle of Moments, Sum of anti clockwise moments = sum of clockwise movements	The teachers asked the student to add weights and verify the Principle of Moments. (Intra Personal/ Interpersonal)	Verify the Principle of Moments.
	Determination of the weight of a body using the Principle of Moments	Balance a meter scale on a stand such that it remains in equilibrium state. The point at which it is pivoted is the centre of gravity G. Suspend a weight W1 from the scale at A on the left side and the given body on B on the right. $W_2 \times d_2 = W_1 \times d_1$ $W_2 = \frac{W_2 \times d_2}{d_1}$	The teacher demonstrated Principle of Moments to find the weight of an object – (Inter personal)	How will you measure the weight of a body by using the Principle of Moments?

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
16	Structure of Atom	Evidence for the structure of atom came from studies of 1.The nature of rays produced in discharge tube 2. The radiations given out by excited gases 3. The nature of radioactivity. J.J.Thomson discovered negatively charged particles – electrons, Goldstein discovered positively charged particles – protons and Chadwick discovered neutrons.	The teacher explained the existence of subatomic particles from the evidence and experiments done by the scientist using flashcards. (Spatial Visual) Teacher explained the discovery of electrons and protons by using blackboard. (Spatial Visual) Teacher explained the discovery of neutrons by using blackboard. (Spatial Visual)	What are sub-atomic particles? Who discovered electron? Who discovered neutron?
17	Discovery of electrons	This tube is fitted with metal electrodes on either ends across which high voltage can be applied. The tube is also connected to a vacuum pump for controlling the pressure of gas inside the discharge tube. On applying high voltage, cathode rays are generated from the cathode and they glow on the spot where they fall upon. **Properties of Cathode Rays** 1. Cathode rays travel in straight lines. 2. Heating effect. 3. Cathode rays consist of material particles. 4. Cathode rays are deflected by electric field towards the positively charged plate. This indicates that they are negatively charged. 5. Cathode rays are deflected by magnetic field.	Teacher demonstrated the discovery of electrons by using a working model. (Bodily Kinesthetic, Spatial Visual) Teacher explained the properties of cathode rays by using flash cards and chart. (Spatial Visual / Linguistic.)	Explain the discovery of electrons. Mention the properties of Cathode Rays.
18	Anode Rays or Canal Rays	Goldstein, in 1886 discovered the existence of a new type of rays in the discharge tube. He used a perforated cathode in the discharge tube. On passing the electric discharge at low pressure, he observed a new type of rays streaming behind the cathode. These rays were named Anode Rays or Canal Rays. These rays consist of positively charged particles.	Teacher explained the discovery of Anode Rays by using a working model (Spatial Visual, Linguistic, Bodily Kinesthetic)	Explain the discovery of Canal Rays.

Lesson No.	Concept	Content	Instructional Strategy	Evaluation
		The properties of Anode Rays are: 1. Anode rays travel in a straight lines. 2. Anode rays consist of material particles. 3. Anode rays are deflected by electric field towards negatively charged plate. This indicates that they are positively charged. 4. Anode rays are deflected by magnetic field. The direction of deflection indicates that they are positively charged. 5. Charge to mass ratio of the particles in the anode rays depends upon nature of the gas taken in the discharge tube. (e/m) ratio is much less than that for an electron.	Teacher explained the properties of Anode Rays by using blackboard. (Linguistic)	What are the properties of Anode Rays?
19	Discovery of protons	A proton is a fundamental particle and a constituent of all atoms. It is the lightest positively charged particle identified by Goldstein. The mass of a proton is equal to 1.673 x 10^{-27} kg or 1.0073 a.m.u. Its charge is the same in magnitude, as the charge of an electron but of opposite sign. So a proton is a particle of unit mass and unit positive charge. It is identical with hydrogen ion $_1H^1$. A proton is produced from a hydrogen atom by knocking out an electron. Charge to mass ratio for protons was found to be 9.58 coulombs/ kg. Charge on proton is opposite but equal in magnitude to the charge on the electron. i.e. 1,602 x 10^{-19} coloumb, From these two observations mass of a proton works out to be 1,675 x 10^{-27} kg. It is practically the same as the mass of a hydrogen atom and is about 1840 times the mass of an electron.	Teacher explained the discovery of protons and gave the values of mass and charge of proton by using flashcards (Logical Mathematical/ (Linguistic)	Explain the discovery of protons. What is charge and mass of a proton?
20	Discovery of Neutron	In 1920, Rutherford predicted the existence of neutral particles, called neutrons. The neutrons were discovered by James Chadwick in 1932. It is the third fundamental particle.	Teacher explained the discovery of neutrons by using blackboard (Logical Mathematical / Linguistic)	Explain the discovery of neutrons.

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		Chadwick bombarded lighter elements like beryllium and lithium nuclei with αparticles. As a result, neutrons were emitted from the metal. ${}_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + {}_0n^1$ Beryllium + Helium → Carbon +neutron		
		Properties of Neutrons The mass of a neutron is $1673x10^{-27}$ kg. It is nearly equal to the mass of a proton. Neutrons are electrically neutral. They are not deflected by electric and magnetic fields. A neutron is a sub-atomic particle carrying no charge and having mass 1.675×10^{-27} kg which is almost equal to that of a hydrogen atom. Therefore, the mass of the atom is largely due to protons and neutrons in the nucleus of the atom.	Teacher explained the properties of neutrons by using flash cards. (Spatial Visual)	What are the properties of neutrons?
21	Ruther ford's Scattering Experiment	The experiment involved the bombardment of a thin sheet of gold (thickness of 4×10^{-5} cm) by α particles. These particles were obtained in the form of a narrow beam by passing through a slit in the lead plate. A circular screen coated with zinc sulphide (ZnS) was placed around the foil to detect the deflection suffered by α particles. 1. Most of the α particles (nearly 99%) passed through the gold foil undeflected. 2. Some of the α particles were deflected by small angles. 3. A few particles (1 in about 10^6) were either deflected by a very large angle or were actually reflected back along their path. **Explanation for the Observations** Since most of the α particles pass through the foil undeflected, it indicates that the most of the space in an atom in empty. α particles being positively charged and having	Teacher explained the scattering experiment by using a dummy model (Spatial Visual/Linguistic/Bodily Kinesthetic)	Explain the Ruther ford's Scattering Experiment.

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		considerable mass could be deflected only by some heavy, positively charged centre. The small angle of deflections of α particles indicated the presence of a heavy positive centre in the atom. This positive centre is nucleus. α particles which make head-on collision with heavy positive centre are deflected through large angles. Since the number of such α particles is very small, the space occupied by the heavy positive centre must be very small.		
22	Ruther ford's nuclear model of atom	1. An atom consists of two parts, a nucleus and a region of space outside the nucleus. 2. Most of the mass and all the positive charge of an atom are concentrated in a very small region called nucleus. 3. The nucleus contains protons,(Neutrons were not known at that time) 4. The magnitude of the charge on the nucleus is different for atoms of different elements. 5. The nucleus is surrounded by electrons, which are revolving around it at very high speed. The electrostatic force of attraction between electrons and the nucleus is balanced by the centrifugal force acting on the revolving electrons. 6. Total negative charge on the electrons is equal to the total positive charge on the nucleus so that atom on the whole is electrically neutral. 7. Most of the space inside an atom is empty. 8. The volume of the nucleus is minute compared to the volume of the atom.	Teacher explained the nuclear model of atom by using black board (Linguistic, Spatial Visual)	Explain the nuclear model of atom.

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23	Atomic Number Mass Number Isotopes	The atomic number of an element is equal to the number of protons in the nucleus of its atom. Atomic number is also equal to the number of electrons in an atom of the element. Atomic Number (Z) = Number of protons or Number of electrons. Total number of protons and neutrons in the nucleus is called mass number of the atom. It is generally represented by the letter A. Mass Number A = number of protons + number of neutrons. Atoms of the same element that differ in mass number are called isotopes. Isotopes have the same number of protons but different number of neutrons. Thus isotopes of an element are the atoms of the element with same atomic number but different mass-numbers.	Teacher explained the atomic number by using flash cards (Spatiall Visual / Linguistic) Teacher explained the mass number by using flash cards. (Spatial Visual / Linguistic) Teacher explained the definition of isotopes by using flash cards. (Spatial Visual / Linguistic)	Define Atomic Number. Define Mass Number. Define Isotope.
	Isotopes of Hydrogen	Hydrogen has three isotopes, Protium (H), Deuterium (D) and Tritium (T). All the three isotopes have atomic number 1, however the mass numbers are 1,2, and 3 respectively. The isotopes of other elements do not have special names; they are indicated by giving mass-number value on the symbol. $_{Z}X^{A}$ A- Mass number **X** - Symbol of element Z – Atomic number Three isotopes of hydrogen can be represented as $_{1}H^{1}$, $_{1}H^{2}$, $_{1}H^{3}$	Teacher explained the isotopes of hydrogen by using blackboard (Logical Mathematical / Linguistic /Interpersonal)	Write down the symbols of the isotopes of Hydrogen.

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24	Bohr's model of Atom	**Postulates of Bohr's Theory:** 1. The electrons revolve round the nucleus in fixed closed orbits, known as stationary states, but no radiation is emitted. Here electrons do not lose energy. The angular momentum of electrons in such orbits is given by n(h/2π) Where n is an integer. 2. The electron orbits are grouped together in shells. A shell is a group of orbits with similar energy. 3. Each orbit is at a different distance from the nucleus. 4. The shells at a distance have higher energy than those close to the nucleus, 5. Electrons fill the shells starting with the first shell, which is closest to the nucleus. 6. Each shell can only hold a certain number of electrons (this maximum number is $2n^2$, where 'n' is the number of the shell from the nucleus) 7. The first shell can only contain up to 2 electrons. The second shell can contain a maximum of 8 electrons. The third shell can contain up to 18 electrons; but for small atoms (those with up to 20 electrons altogether) the third shell will to hold more than 8. 8. The outer electrons of some atoms can be removed fairly easily to form ions. 9. Chemical bonding between atoms to form molecules involves the electrons in the outer shell only. 10. An atom radiates energy when an electron falls from a higher to lower orbit. It absorbs energy in changing from a lower to a higher energy level. If E is the energy associated with the electron in an outer orbit and E1 is associated with the electron in the next inner orbit then E_2-E_1=hע or AE = hע, where AE is the difference in energy and 'h' is the Planck's Constant,	Teacher explained the postulates of Bohr's Theory by using blackboard. (Linguistic,/ Logical Mathematical)	Explain the postulates of Bohr's Theory.

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	Superiority of Bohr's model over Rutherford's model	'ע' is the frequency of radiation emitted. 11. The electron in motion in an orbit is subjected to two forces. (a) The electrostatic force of attraction between nucleus and electron (b) The centripetal force of the electron to go away from the orbit. They are equal in magnitude but opposite in direction. So the electrons have stability. 12. The angular momentum of an electron revolving in an orbit should become integral multiples of h/2ת (h= Planck's Constant) 13. The energy of an electron in an orbit was calculated by Bohr. 14. Atoms can emit or absorb energy only in specific amounts (quanta). The quanta involved depend on the orbit to which electron is entering and leaving. Bohr's model could explain the stability of an atom. An electron revolving in a particular orbit cannot lose energy. The electron can lose energy only if it jumps to some lower energy level. If no lower energy level is vacant then electron will keep on revolving in the same orbit without losing energy. Hence there is stability. In the case of Rutherford's model, when the electron loses energy, it has to confine to spiral path. So there could not be stability. 2. Bohr's theory helped in calculating energy of an electron in a particular orbit of hydrogen. It is possible to derive a mathematical relation for energy of an electron in the n^{th} orbit of hydrogen. 3. Bohr's model could explain the atomic spectrum, of hydrogen.	Teacher explained the limitations overcome by Bohr's model by using blackboard. (Linguistic/Interpersonal)	Give the superiority of Bohr's model over Rutherford's model.

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25	Electronic Configuration of elements Valency Valence Electrons	The electronic configuration of elements means the distribution of electrons in the orbital of their atoms. The number of electrons in an atom is equal to atomic number of the element. These electrons are distributed in various orbital in the increasing order of energy. These orbital are called s, p, d, f. The outermost shell of an atom is called valence shell. Valency is defined as the combining capacity of an element. The electrons gained or lost by an atom of an element during a chemical reaction are called Valence Electrons.	Teacher explained the electronic configuration of elements by using a dummy model (Logical Mathematical/ Linguistic/ Interpersonal) Teacher explained the definition of valency with an example. Teacher explained the definition of valence electrons by using flash card. (Spatial Visual)	Give the electronic configuration of neon. . Define Valency Give the Valency of oxygen. Define Valence Electrons.
26	Radio Activity	Madame Curie soon discovered two more elements which were also radioactive. One of them is called radium and the other one is Polonium. Thorium is also a radioactive element. Nowadays we have artificial radioactive elements. The action of radioactive radiation on a photographic plate forms the basis of another method of detection of radioactivity. The track of the charged particles is traced on the photographic plate. Three types of rays are emitted out in radioactive phenomenon. They are α β Ÿ rays, α rays containing positively charged particles bend towards negative electrical fields. β rays which are negatively charged bend towards positive electrical field. Ÿ rays are electromagnetic radiations which are neutral, they are unaffected by electrical field.	Teacher explained the three types of radioactivity using a model (Bodily Kinesthetic/ Spatial Visual)	Explain the different types of radiation.

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27	Uses of Radio Activity	**In Medicine** 1. Radio-cobalt Co-60, U-238 are used in the treatment of cancer and tumors. 2. Radio-iodine (I-123) is used in the treatment of thyroid cancer. 3. Phosphorus-32 or Strontium-90 is used to cure skin cancer. 4. Medical instruments can be sterilized. 5. Tritium and Carbon-14 are commonly used to label biological molecules. 6. Radio active-Iron (Fe-59) isotope is used to treat anemia **In Agriculture** 1. Radioactive phosphorous, P-32 is used with fertilizers to study the phosphorous intake in growing plants. 2. Radiations from Radio-isotopes are used for developing high yield varieties of rice and wheat. **In Science** 1. Gamma rays are used in the study of the structure and properties of atomic nuclei. 2. Radiations are used to analyze the structural formula of substances. 3. Radio-Iodine can easily identify the silver remains in a reaction. 4. Radioisotopes are used as ‘tracer’ elements in chemical reactions. 5. Radio isotopes are used in neutron activation analysis to identify arsenic poisoning. **In Industry** 1. Radio-isotopes are used to detect leaks in pipelines. 2. Gamma rays are used to measure the thickness of thin sheets of paper or steel.	Teacher explained the uses of radioactivity by using flash cards. (Spatial Visual/Linguistic)	State the uses of Radio activity in various fields.

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		3. Ÿ- β radiation is used to monitor the level of filling in containers. 4. Radioactive tracing can be used to check the effectiveness of lubricating oil. **In Archaeology** 1. The age of fossils and rocks can be determined using radioactive isotope of carbon since it has half life of 5730 years. This is called radio-carbon dating. The oldest rock so far dated was found in northern Canada and is 3.96 x 10^9 years old. Radioactive dating of meteorites and rocks from the moon suggests that all the solar systems was formed at the same time about 4.6 x 10^9 years ago. **In Food Treatment** Ÿ Radiation is used to kill bacteria. The presence of micro-organisms cause food-spoilage or toxicity or food poisoning. Salmonella and Clostridium are disease carrying organisms. They can be killed on exposure to Ÿ radiation.		
	Properties of α, β Ÿ, rays	**Alpha Radiation (**α particles) 1. Alpha particles are made up of the nucleus of helium atom, 2. A well-known source of alpha-radiation is the most abundant isotope uranium-238. 3. It is the largest particle emitted by radioactive substances. 4. It has very little penetrating power. 5.Since they are massive and they possess a pretty large velocity, they possess a large amount of kinetic energy. Therefore, they are used as projectiles in artificial transmutation.	Teacher explained the properties of α, β Ÿ by using chart and black-board (Spatial-Visual/ Linguistic /Interpersonal)	State the properties of α, β and Ÿ rays.

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		Beta Radiation (β particles) 1. β rays are material particles. They are electrons. 2. They produce moderate ionization in air. 3. Their range is not well defined as that of α rays. 4. They travel with very high velocity and sometimes it reaches nearly the velocity of light. **Properties of Ÿ rays** 1. Ÿ,-rays are not material particles like a and β rays. But they are electromagnetic waves of extremely small wavelengths. 2. Ÿ,-rays are invisible. 3. They can ionize gases. 4. They can produce fluorescence. 5. Being electromagnetic waves, they are not deflected by electric and magnetic fields. 6. They are diffracted by crystals. 7. They are more penetrating than X-rays because their wavelength is shorter than that of X-rays. 8. These rays are most dangerous because they can kill living tissues by their bombardment. 9. When Ÿ rays are emitted by a radioactive nucleus, the nucleus does not change its chemical character. 10. The release of Gamma rays usually occurs together with α and β radiation. 11. They emit β rays or electrons when incident on matter. All radioactive emissions affect the atoms or molecules of any material through which they pass. The radiations knock electrons out of atoms to produce positive ions and so these are sometimes called ionizing radiations. If they affect he DNA molecule in a cell, it can die or become cancerous, growing out of control.		

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		The time taken by a radio active substance to reduce to half of its original mass is constant for a particular radio-isotope. This time is called the half-life period. This is useful for Radio-carbon dating. The age of rocks, wooden and organic objects may be measured by this method. Radio active rays can be detected using 1. Electrometer 2. Cloud Chamber 3. Geiger Muller counter 4. Semi Conductor Circuits		