Chapter 1

INTRODUCTION

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INTRODUCTION

My dear children: Bear in mind that the wonderful things that you learn in your schools are the work of many generations, produced by enthusiastic effort and infinite labour in every country of the world. All this is put into your hands as your inheritance in order that you may receive it, honour it, and add to it, and one day faithfully hand it on to your children. If you always keep this in mind you will find meaning in life and work and acquire the right attitude towards other nations and ages (Einstein, 1934 as cited in Kevin, 1995).

Science and technology have been central to India’s developmental efforts since independence. Jawaharlal Nehru, the first Prime Minister of India, a firm believer in the crucial importance of science and technology for economic growth and social transformation, helped to lay a firm foundation of science education in the country. It is being realized that advancement in the nation’s move towards a welfare state is possible only through a scientifically literate population.

Under such a scenario it has become vital that there should be a strong science base in the country, especially in children. It is a matter of concern to perceive that there is a fall in the number of youngsters seeking careers in science and it is disturbing to have a situation where scientists of excellence are hard to find. Teachers are expected to devise proper methods for developing positive attitudes towards science and science-related disciplines in their students. “Goals and standards for science education have been established; the big challenge is implementing them” (Anderson & Krathwohl, 2001, p.3).
There has been a significant shift in the history of education: a shift from the traditional teacher-centred approaches to learner-centred ones. With the emergence of ‘humanism’ in the sixties, new perspectives in teaching methodology came to the scene. These ideas were the direct result of the new outlook of the student. The conventional, authoritative and teacher-centred instruction has given way to the learner-centred mode of instruction. Educators started paying attention to the impact that learners’ affective factors may bring in the process of learning (Lin, 2000).

The great educators throughout human history have understood the value of learning. Plato, cited in Campbell (1997) states his advice to educators saying, “Do not then train youth to learning by force and harshness, but direct them to it by what amuses their minds so that you may be better able to discover with accuracy the peculiar bent of the genius of each” (p.3) Educational research tells us ‘one size does not fit all’ (Reigeluth, 1999). Educators are always concerned about what educational methods can benefit the learners the most. Gardner’s (1983) Multiple Intelligence Theory (MI Theory) is potentially one of them. Gardner claimed that educational methods should be created and adjusted to be more flexible for students who have different intellectual capacities, and should be re-designed and rearranged to use the multiple intelligences effectively so that those changes would benefit students, teachers and society.

Educators and psychologists began to view education according to this new perspective; they highlighted the necessity for caring for the learners’ individual differences and learning styles because they represent the foundation upon which instructors should build their instructional methods. Gardner suggests that the
challenge of this millennium is whether we can make these differences central to
teaching and learning or whether we will instead continue to treat everyone in a
uniform way. “Gardner proposes ‘individually configured education’, an
education that takes individual differences seriously and craft practices that serve
different kinds of minds equally well” (Berman, 2001, p.5).

With this revelation, a lot of groundbreaking work has laid a foundation for
understanding individual differences, such as personality types, learning styles and
multiple intelligences. Unfortunately methods of instruction remain more or less
the same for all students in the classroom. The failure of helping all students to
develop and expand their abilities is a lost to the country as well as the community.
It is clear that teachers or the academic instructors should change their teaching
strategies and materials to cater to the needs and preferences of all students.

1.1 Theory of Multiple Intelligences (MI)

I would happily send my children to a school that takes differences
among children seriously, that shares knowledge among differences with
children and parents, that encourages children to assume responsibility for
their own learning, and that presents materials in such a way that each
child has the maximum opportunity to master those materials and to show
others and themselves what they have learned and understood (Gardner,
1999, pp. 91-92).

After years of research, Gardner (1983) proposed a new theory and
definition of intelligence in his book entitled Frames of Mind: The Theory of
Multiple Intelligences. The basic question he sought to answer was: Is intelligence
a single thing or various independent intellectual faculties? Gardner is the
Professor of Cognition and Education at the Harvard Graduate School of Education. He also holds an adjunct faculty post in psychology at Harvard and in neurology at Boston University School of Medicine. He is best known for his work in the area of MI, which has been a career-long pursuit to understand and describe the construct of intelligence (Gardner, 1999a).

In the heyday of the psychometric and behaviourist eras, it was generally believed that intelligence was a single entity that was inherited; and that human beings - initially a blank slate - could be trained to learn anything, provided that it was presented in an appropriate way. Nowadays an increasing number of researchers believe precisely the opposite; that there exists a multitude of intelligences, quite independent of each other; that each intelligence has its own strengths and constraints; that the mind is far from unencumbered at birth; and that it is unexpectedly difficult to teach things that go against early 'naive' theories of that challenge the natural lines of force within an intelligence and its matching domain (Gardner, 1993, p.23).

According to Gardner (1999), intelligence is much more than IQ because a high IQ in the absence of productivity does not equate to intelligence. In his definition, “Intelligence is a biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture.” (p.34). He illustrates this point by examining the way sailors in the South Seas direct their ships by looking at constellations of stars in the sky, feeling the way a boat passes over the water, and noticing a few scattered landmarks. ‘Intelligence’ in these sailors’ society would probably refer to
navigational ability. Surgeons and engineers, hunters and fishermen, dancers and choreographers, athletes and athletic coaches, tribal chiefs and sorcerers may all have different building blocks of the intelligences that give them their ability to ‘solve problems or fashion products’ (Gardner, 1996, p.7).

Consequently, instead of intelligence being a single entity described psychometrically with an IQ score, Gardner's definition views it as many things. He endeavoured to define intelligence in a much broader way than psychometricians. To achieve this goal Gardner (1983) established several criteria for defining intelligence. In identifying capabilities to be considered for one of the ‘multiple intelligences’ the construct under consideration had to meet several criteria rather than resting on the results of a narrow psychometric approach.

Based on his study of many people from many different walks of life in everyday circumstances and professions, Gardner developed the theory of MI. In brief, Gardner suggested that all human beings possess all eight intelligences in varying amounts and each person has a different intellectual composition. These intelligences are located in different areas of the brain and can work either independently or together (Gardner, 1998).

The end product of Gardner’s research is the eight intelligences: (1) **Verbal/linguistic**: sensitivity to the sounds, rhythms, and meanings of words; sensitivity to the different functions of language. (2) **Logical/mathematical**: abilities to discern logical or numerical patterns and to handle long chains of reasoning. (3) **Visual/spatial**: capacity to perceive the visual-spatial world accurately and to modify or manipulate one's initial perceptions. (4) **Bodily/kinaesthetic**: abilities to control one's body movements and to handle
objects skilfully. (5) **Musical/rhythmical:** abilities to produce and appreciate rhythm, pitch, and timbre, and appreciation of the forms of musical expressiveness. (6) **Interpersonal:** capacities to discern and respond appropriately to the moods, temperaments, motivations, and desires of other people. (7) **Intrapersonal:** knowledge of one's own feelings, strengths, weaknesses, desires, and the ability to draw upon this knowledge to guide behaviour. (8) **Naturalistic:** the potential for discriminating among plants, animals, rocks, and the world around us, as used in understanding nature, making distinctions, identifying flora and fauna (Gardner, 1999).

Gardner’s (1983) provisional list includes seven intelligences, each with its own component processes and subtypes and then he (Gardner, 1997) identifies an eighth intelligence (naturalistic). Gardner (1999) has considered adding either existential or spiritual intelligence as a ninth one but not yet been endorsed due to a lack of empirical psychological and neurological evidences (Gardner, 1999a; Viens & Kallenbach, 2004).

According to Gardner, these multiple intelligences are inherent in all individuals in varying amounts. They are present at birth as ‘raw biological potentials’ (Gardner, 1995) and develop in accordance with the culture and experience of the individual. Gardner believes that each individual can get better at each of the intelligences, although some people will improve in an intelligence area more readily than others (Gardner, 1997a). These different intelligence profiles determine how and what we learn, and form the basis of Gardner's approach to educational practice.
Tracy and Rose (1992) in *Accelerated learning techniques* cited Albert Einstein as an example to state that intelligence is not fixed but increases with stimulation. According to them Albert Einstein was a very poor student. He could not speak until he was four, and he could not read until he was seven. His teachers thought he had learning disabilities and could never be truly educated. One day his curiosity in what made his ‘toy magnet’ attract metal so fascinated him that he began to brush up on his mathematics, and little by little he learned.

Einstein’s brain has been studied by brain researchers, and only one difference has been found between his brain and that of others: it shows very rich connections between brain cells. Anytime we think a new thought or explore a topic in a new way, we make the more connections between our brain neurons and dendrites. With more connections, we have more brain capacity and therefore have more potential for intelligent thought. This is true at almost any age. Therefore, intelligence is not fixed but increases with stimulation (Tracy & Rose, 1992).

Gardner's MI model broadens our perceptions of what is meant to be intelligent. The MI theory continues to open the minds of educators, psychologists, learners and parents as to how learning and education can be changed so that all persons may be guided to achieve their maximum potential.

1.2 Criteria behind the Selection of the Study

In recent years, increase in class size, the diversity of student populations and changes in the expectations of students have all acted as stimuli for an examination of approaches to teaching and learning. The problems of quantity and quality in education have posed serious problems in our country. The quality of education is largely dependent on the quality of instruction provided in the classrooms. So
proper attention should be paid to change the strategy of instruction and efforts should be made to introduce new methods and evolve new techniques of instruction suiting to the national needs.

In order to meet the needs of a diverse student population, teachers need to integrate a repertoire of instructional strategies to help all students learn. “The ‘drill and skill’ lecture method may appeal to some of the parents and students, but more and more of the students do not respond to that method” (Burke, 2000, p.18).

All too often, teachers teach in their preferred learning method without taking into consideration how a student learns. Based on the statistics then, if a teacher’s preferred learning style is auditory and lecturing is the only instructional method used, he/she has missed 75% of the students’ population. This mismatch of the teachers’ learning/teaching style and the student’s learning style is one of the biggest reasons for academic underachievement and frustration (Tracy & Rose, 1992).

To reform science education, educators have begun to focus on effective science teaching and learning, through a more student-centred and meaningful approach to science education. Multiple intelligences theory makes its greatest contribution to education by suggesting that teachers need to expand their repertoire of techniques, tools, and strategies beyond the typical linguistic and logical ones predominantly used in the classroom (Armstrong, 2000). However, the cultural or intelligence-adaptive pedagogy will not succeed until we know each student’s intelligences profile. It is expected that maximum learning motivation will occur when there is a match between a student’s MI strengths and teaching pedagogy. With the knowledge of MI and learning style theory, educators can
integrate various learning strategies so that students bombard their minds in many
different ways with new ideas and remain engaged in the educational process.

In education, as students advance to higher grade levels, fewer senses are
involved in learning, and it isn’t nearly as much fun as in the lower grades. Fewer
of our MI are engaged in the learning process as we progress. Students experience
frustration and failure; and by the time they are teenagers, only one in five has
confidence in his/her ability to be successful in school. If we treat everybody as if
they are the same, we are catering to one profile of intelligence, the language-logic
profile. It is great if you have that profile, but it is not great for the vast majority of
human beings who do not have that particular profile of intelligence (Gardner,
1997).

Each child is a unique individual with unique learning needs. According to
the MI theory these unique needs are linked to the child's intelligences. A child
will learn best when taught through his or her personal and specific intelligences
because it is the way that he or she learns best. Gardner’s belief is that if children
were taught through all of the MI, their learning would be enhanced (Gardner,
1997).

According to Gardner, educators do not ask enough questions to themselves
about what they are trying to achieve. “Educators need to focus on a manageable
number of key concepts and explore them in depth. Mastery of a concept or theory
requires repeated exposures. It is a mistake to present all in the same content”
(Gardner, 2006, p.60).
Gardner (2006) describes the idea of using MI as different ‘doorways’ into domain/concept/theory.

Some students will learn from linguistic entry, others from artistic or personal or logical entry points: some will learn one subject best via one entry point, another subject via another entry point. These multiple approaches to a topic convey to students what it is like to be a disciplinary expert. An expert is distinguished by the fact that he/she can think of a topic or skill in a variety of ways. Finally, through these multiple approaches, one activates different clusters, or neural networks, to the extent that different clusters are activated and eventually connected, obtains a solid and enduring mental representation of the topic in question (Gardner, 2006, p.60).

Gardner’s theory advances the idea that all individuals possess different intellectual strengths, supporting the proposition that the design of information should take this difference and diversity into account. Currently, the presentation of information in countless contexts emphasizes linguistic and logical intelligences. It assumes that everyone is equally intelligible for the assimilation of the same information provided in the same way. In fact, it is exactly the opposite because the emphasis on text-based information and textually-defined information hierarchies, disregards the individual’s cognitive needs and differences.

1.3 Need and Significance of the Study

The problem that all educators invariably encounter in teaching different subjects, at different grade levels of our educational system is how to teach a
lesson to a class that consists of students with different skills, learning pace and learning styles. Another challenge in education is to make learning more effective, interesting, exciting and less time consuming.

In this context, Gardner’s MI theory has met with a strongly positive response from many educators. It has been embraced by a range of educational theorists and, significantly, applied by teachers and policymakers to the problems of schooling. According to Gardner, “At first blush, this diagnosis would appear to sound a death knell for formal education. It is hard to teach one intelligence; what if there are seven?” (Gardner, 1993).

However, Gardner’s MI theory has not been readily accepted within academic psychology. Gardner responds by pointing out that psychology does not directly dictate education; it merely helps one to understand the conditions within which education takes place. Seven kinds of intelligence would allow seven ways to teach, rather than one and powerful constraints that exist in the mind can be mobilized to introduce a particular concept (or whole system of thinking) in a way that children are most likely to learn it and least likely to distort it. Paradoxically, constraints can be suggestive and ultimately freeing (Gardner, 1993).

Gardner notes that traditional IQ tests measure only logic and language, yet the brain has other equally important types of intelligences. Gardner argues that all humans have these intelligences, but people differ in the strengths and combinations of intelligences. He believes that all of them can be enhanced through training and practice. MI thus belongs to a group of instructional perspectives that focus on differences between learners and the need to recognize
learner differences in teaching. Learners are viewed as possessing individual learning styles, preferences, or intelligences. Pedagogy is most successful when these learner differences are acknowledged, analyzed for particular groups of learners, and accommodated in teaching (Gardner, 1997b).

By addressing the intellectual strengths of various students, Gardner proposed the process of education might be better tailored to meet the diverse needs and learning styles of students in a course. This indeed is the central tenet of Gardner’s work. It is important to note that Gardner is not an educator by training, he is a psychologist. Therefore, educators may experience difficulty in applying a somewhat abstract psychological theory for a classroom with dynamic children. MI theory is best thought of as a tool, rather than as an educational goal (Gardner, 2006). Hence educators need to determine, in conjunction with their communities, the goals that they are seeking. Once these goals have been articulated, then MI theory can provide powerful support.

Gardner believes teachers should use MI in lessons because it helps students relate to real world experiences (Smith, 2002). The research literature suggests that MI applications in school settings have been found to be associated with a wide range of positive outcomes and it is readily accepted by many primary school educators. But there appears to be limited focused research which addresses the relationship of MI instructional approaches and student achievement indicators within the setting of secondary school classrooms. Gardner recognizes the need for further research in the educational application of MI theory. Gardner (1993) himself, in his book *Frames of Mind*, warns that his theory needs to be amply discussed and tested.
Gardner has been totally honest and forthright about the lack of experimental research on his theory. He notes,

*While MI theory is consistent with much empirical evidence, it has not been subjected to strong experimental tests. ... Within the area of education, the applications of the theory are currently being examined in many projects.*

*Our hunches will have to be revised many times in light of actual classroom experiences* (Gardner, 1993, p.33).

The investigator believes that the traditional focus of schools on the linguistic and logical-mathematical intelligences have meant that many students, whose intelligence profiles cannot be fitted this traditional model, have been left on the sidelines. Often these students have gone on to use their unique blend of intelligences to achieve success in the real world outside of school, which would not have been predicted by traditional scholastic tests. Tragically for many, this may lead to frustration, academic failure and unhappy school experiences that can have a negative impact on their self-esteem and behaviour, and consequently their later achievements in life.

As Weber (1999) asks, “Why, then do schools so often leave our students’ gifts untapped, their talents untouched, and their dreams unfulfilled?” (p.104). Hence reaching all students with different combinations of MI is necessary for full academic growth in school.

1.4 Statement of the Problem

The aim of the present study was to find out whether the Multiple Intelligence Approach (MIA) is feasible in the secondary school context, and to measure its relative effectiveness with Conventional Method of Direct Instruction
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The study of this problem may provide more information as to what curriculum methods can help the students at risk. This study may also provide information that can be used by secondary school counsellors, therapists, alternative education programmers, educators and other human service disciplines. This study also aimed at preparing and experimenting specially designed study materials based on the MI Theory of Gardner.

Hence the topic selected for this purpose is entitled as “EFFECTIVENESS OF MULTIPLE INTELLIGENCE APPROACH ON ACHIEVEMENT IN BIOLOGY OF SECONDARY SCHOOL STUDENTS.”

1.5 Definition of Key Terms

Multiple Intelligence Approach (MIA)

Multiple Intelligence Approach (MIA) refers to the instructional strategy based on the MI Theory of Howard Gardner. He defines intelligence as “biopsychological potential to process information that can be activated in a cultural setting to solve problems or create products that are of value in a culture” (Gardner, 1999, pp.33-34).

From an understanding of intelligence as contextual and cultural, Gardner proposes that individuals perceive the world through at least eight different intelligences, these being verbal/linguistic, logical/mathematical, visual/spatial, bodily/kinaesthetic, musical/rhythmic, interpersonal, intrapersonal and naturalistic (Gardner, 1999).

This theory suggests that there are at least eight ways through which people perceive and understand the world. Gardner labels each of these ways as distinct
“intelligence”, a set of skills allowing individuals to find and resolve genuine problems they face.

1.6 Objectives of the Study

1. To prepare and standardize a Multiple Intelligence Inventory (MI Inventory)

2. To find out the level of achievement of students when Conventional Method of Direct Instruction (CMDI) is used in teaching biology at secondary level.

3. To find out the level of achievement of students when Multiple Intelligence Approach (MIA) is used in teaching biology at secondary level.

4. To compare the effectiveness of MIA with that of the CMDI on the total achievement in biology of secondary school students.

5. To compare the effectiveness of the MIA with that of the CMDI on the achievement in biology of secondary school students with respect to different objectives of Cognitive domain such as
   a) Remembering,
   b) Understanding,
   c) Applying,
   d) Analysing,
   e) Evaluating and
   f) Creating.
6. To compare the effectiveness of MIA with CMDI on the achievement in biology of secondary school students having different Learning styles such as
   a) Diverging style,
   b) Assimilating style,
   c) Accommodating style and
   d) Converging style

7. To compare the effectiveness of MIA on the achievement in biology of secondary school students having different Learning styles such as
   a) Diverging style,
   b) Assimilating style,
   c) Accommodating style and
   d) Converging style.

8. To compare the effectiveness of MIA on the achievement in biology of secondary school students having different levels of MI such as
   a. Verbal/Linguistic,
   b. Logical/Mathematical,
   c. Visual/Spatial,
   d. Bodily/Kinaesthetic,
   e. Musical/Rhythmical,
   f. Interpersonal,
g. Intrapersonal and

h. Naturalistic.

1.7 Hypotheses of the Study

The hypotheses formulated for the present study were;

1. Multiple Intelligence Approach (MIA) is more effective than Conventional Method of Direct Instruction (CMDI) on the total achievement in biology of secondary school students.

2. Secondary school students taught through MIA have better academic achievement in biology with respect to Remembering level than those taught through CMDI.

3. Secondary school students taught through MIA have better academic achievement in biology with respect to Understanding level than those taught through CMDI.

4. Secondary school students taught through MIA have better academic achievement in biology with respect to Applying level than those taught through CMDI.

5. Secondary school students taught through MIA have better academic achievement in biology with respect to Analysing level than those taught through CMDI.

6. Secondary school students taught through MIA have better academic achievement in biology with respect to Evaluating level than those taught through CMDI.
7. Secondary school students taught through MIA have better academic achievement in biology with respect to Creating level than those taught through CMDI.

8. Multiple Intelligence Approach is more effective than CMDI on the achievement in biology of secondary school students having Diverging learning style.

9. Multiple Intelligence Approach is more effective than CMDI on the achievement in biology of secondary school students having Assimilating learning style.

10. Multiple Intelligence Approach is more effective than CMDI on the achievement in biology of secondary school students having Accommodating learning style.

11. Multiple Intelligence Approach is more effective than CMDI on the achievement in biology of secondary school students having Converging learning style.

12. There is no significant difference on the achievement in biology of secondary school students having different Learning styles when taught through MIA.

13. There is no significant difference on the achievement in biology of secondary school students having different levels of MI when taught through MIA.
1.8 Scope of the Study

User’s evaluation is considered as a critical success factor in any innovative approach in learning. The study examines the relative effectiveness of MIA over CMDI on the achievement in biology of secondary school students. It is hoped that the findings of the study will be useful for the learners, teachers, trainers and curriculum designers. Work in this area should help to create pedagogically sound learning strategies, which are robust and well designed.

Strategies of teaching and learning triggered by MIA will open new perspectives for the education and training of skills and abilities in terms of flexibility, interactivity and autonomy.

In our culture, we tend to ascribe to the surgeon greater intelligence than that of the dancer, and to the physics professor greater intelligence than the mechanic who repairs his/her car. But Gardner forces us to ask whether the intelligence possessed by one group is greater/superior or simply different from the intelligence possessed by others. Our answer has significant implications for the classroom. Schools that use MI theory encourage learning that go beyond traditional books, pens, and pencils. Teachers and parents who recognize their learners’/children’s particular gifts and talents can provide learning activities that build on those inherent gifts. As a result of strengthening such differences, individuals are free to be intelligent in their own ways.

Designing learning materials based on MIA is a highly sensitive, complicated and time consuming process; but if prepared in the pedagogically sound way, it is able to offer quickly accessible information to students of all learning abilities in an interesting way. This will help the students to properly
structure their schemata of conceptual knowledge and allow them to become better learners as well as problem-solvers.

1.9 Limitations of the Study

Due to lack of time, the study was limited to only secondary schools of Kerala and that too, to one subject, biology, on one topic “sense organs”. The investigator selected only three schools. The sample selected for the study consisted of 188 students only because of practical difficulties in conducting the experimental study of control group - experimental group, pre-test – post-test design.

1.10 Organisation of the Report

The research report consists of six chapters.

Chapter 1: Introduction

This chapter consists of a general introduction highlighting the significance of science education with special reference to MIA. This chapter also presents the reason for selecting the problem, statement of the problem, definition of key terms, objectives of the study, hypotheses of the study and a brief discussion on the scope and limitations of the study.

Chapter II: Theoretical Overview

This chapter deals with the theoretical basis of MIA.

Chapter III: Review of Related Literature

A brief review of the related studies as well as scholarly works done by researchers with more proximity to the present one is included in this chapter.
Chapter IV: Methodology

It discusses about the methodology adopted for the study including the variables used, design of the study, selection of sample, preparation of materials and tools used for the study and statistical procedures adopted.

Chapter V: Analysis and Interpretation of Data

It deals with the analysis and interpretation of data collected during the course of the study.

Chapter VI: Summary, Conclusions and Suggestions

This chapter presents the summary of the procedures adopted for the study followed by conclusions, educational implications and suggestions for further research.