CHAPTER I
INTRODUCTION

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1.1 Introduction

Education is a purposive, conscious or unconscious, psychological, sociological, scientific and philosophical process, which brings about the development of the individual to the fullest extent and also the maximum development of the society in such a way that both enjoy maximum happiness and prosperity. Education is the development of the individual according to the needs and demands of the society, of which he is an integral part.

In the narrower sense, education is regarded as equivalent to instruction. It consists of the “specific influences” consciously designed in a school or in a college or in an institution to bring about the growth and development of the child. The school represents formal education as it imparts education directly and systematically. There is deliberate effort on the part of the educator to inculcate certain habits, skills, attitudes or influences in the learner, which are considered to be essential and useful to him/her, which lend a hand to escort a valuable life. If we expect students to learn appropriate competencies and skills, we must structure the learning environment so that these can be addressed and practiced (Dollman et al., 2007).

The teaching-learning process in any nation goes on from one generation to the next in a planned manner. The process of teaching-learning aims at the transmission of knowledge, imparting skills and formation of attitudes, values and behaviour. Over the last two decades, there has been a shift in the teaching-learning process. Instead of characterizing it as a simple acquisition process based on teacher transmission, learning is now more conceptualised as a process whereby students actively construct their knowledge and skills (Barr and Tagg, 1995). Educators are becoming mentors and scaffolders of learning who show children how and where to access information quickly and efficiently. There has been a fundamental shift from teacher directed instruction to student centred instruction where pupil learn by exploring, predicting, reflecting, problem solving and investigating concepts (Dwivedi, 2010). Student centred instruction ensure flexibility among students to construct knowledge while engaged in the process of learning.

People differ in the ways they approach learning. All students have strengths and abilities, but each student may have a preferred way of using these abilities for learning. Students learn in different ways and vary in their abilities to perform certain
tasks. The way in which the students approach the learning tasks and the behaviour in learning situations determines their learning style. Students with different learning styles understand and try to solve problems through different, relatively stable ways. The different styles of conceptualization and patterning of activities may be the most important characteristics of an individual in respect of learning (Tyler, 1978). The person who learns best by a particular learning style is titled after the particular style. In this sense we can classify the learners according to their learning styles.

The teaching and learning styles of the classroom instructor and students have important implications for effective teaching. For many years educational leaders have recognized the need for alternative instructional approaches to meet the wide variety of students in classrooms. Students are varied in their needs and interests. Teachers can become frustrated knowing they are failing to meet the needs of a portion of students in their classroom. Not being able to accommodate the unique learning styles of students is one reason for this problem. When the teachers are able to analyse the differences and needs of their students, the educational process is likely to become optimized for both students and teachers.

1.1.1 Learning Styles

It is known that the learning process varies from person to person due to biological and psychological differences. As Pask (1988) points out, more than three-fifths of a person’s learning style is biologically imposed. Moreover, Reiff (1992) states that all learners have individual attributes relating to their learning processes. Learners have different strategies, approaches and capabilities for learning that are a function of prior experience and heredity. Individuals are born with and develop their own capabilities and talents. In addition, through learning and social acculturation, they acquire their own preferences for how they like to learn and the pace at which they learn.

Learning Style refers to the pattern of behaviour an individual uses for new learning. The importance in understanding Learning Styles is to develop one’s strengths to the fullest, while addressing deficiencies, thereby creating a more balanced or whole individual. In her book, ‘Learning Styles: Quiet Revolution in American Secondary Schools’, Rita Dunn, describes Learning Style as, "... a biologically and developmentally imposed set of characteristics that make the same
teaching method wonderful for some and terrible for others.... Learning Style also considers motivation, on-task persistence, or the need for multiple assignments simultaneously, the kind and amount of structure required, and conformity versus nonconformity levels" (Dunn, 1988). To be effective, educators must address what Dunn refers to as those "imposed set of characteristics," thereby making education wonderful for all. Schroeder (1993) suggests that a new and very different type of student exists today, a student who does not succeed in the traditional, content laden, passive learning system. Although Schroeder focuses on post-secondary education, and his findings are applicable to all levels.

McCarthy (2000) described “learning styles” as the “individual’s perception and use of the knowledge.” McCarthy categorizes learning styles into four groups. The learners of the first group are the Imaginative (Innovative) learners, of the second group are the Analytic learners, of the third group are the Common Sense learners and the fourth group are the Dynamic learners.

Learning Styles are a set of factors, behaviours, and attitudes that facilitate learning for an individual in a given situation. There is no right way to learn, but there are certain styles that are more appropriate for a given situation. Thus, when an individual learns, the style may be unique to the task or it may duplicate a previous experience (Entwistle, 1981). If teachers teach exclusively in a manner that favours their students’ less preferred learning style modes, the students’ discomfort level may be great enough to interfere with their learning. On the other hand, if teachers teach exclusively in their students’ preferred modes, students may not develop the mental dexterity they need to reach their potential for achievement in school and as professionals. Teaching strategies that encompass varied learning styles in the classroom will allow students to learn through their preferred individual styles and be challenged to learn through their less preferred styles. In order to facilitate academic success, it is important to provide learning experiences that are accessible to all students with all learning preferences.

Schools have to realise that there can hardly be a one-size-fits-all approach for addressing learner diversity. To ensure effective learning for all students in the classroom, teachers need to develop sensitivity to individual students’ needs and respond to them by flexibly adapting their teaching strategies and content. With a good grasp of students’ characteristics, teachers can turn learner diversity into an asset...
by capitalising on their different talents, interests and backgrounds brought to the classroom setting. Teachers can give their students opportunities to develop their potential. Quality instruction is reflected by teachers’ ability to respond appropriately and flexibly to students’ learning styles. Teachers adjust their teaching strategies to support individual students’ learning. According to Tomlinson (1999), the learning, the content, process, and product can be differentiated to create different learning experiences for students with different abilities, readiness, interests and learning preferences. To put this in practice, teachers need to understand students’ learning needs to vary the learning objectives, expand or reduce the learning content, adjust the instructional materials and the demands of the expected output accordingly.

1.1.2 Hemispheric Preferences

Hemisphericity is the cerebral dominance of an individual in retaining and processing of information in his own style of learning and thinking (Venkataraman 1996). Researches conducted during the last two decades have shown that the human left cerebral hemisphere is to be specialized for primarily verbal, analytical, abstract, temporal and digital operations (Bogen, 1969; Gazzaniga, 1989; and Ornstein 1972). The same investigations revealed that the right cerebral hemisphere is to be specialized for primarily non-verbal, holistic, concrete, creative, analogic and aesthetic functions. The specialized functions of each hemisphere appear well lateralised and established early in life (Kinsbourne, 1978) and barring special intervention or insult, continue essentially unaltered throughout the normal life span. For identifying the hemisphere dominance, the ways in which and the levels at which the information is being processed by the individual are to be studied. Tools have been developed to study the "Style" of Learning and Thinking and hence it would be possible to infer the dominance of an individual.

According to McCarthy (1980), the two halves of the brain process information differently. Although both hemispheres are equally important, they carry out different functions. For instance, speech resides primarily in the left hemisphere while spatial capability resides in the right. At the same time, the two hemispheres differ in terms of the way they process information. For instance, linear, sequential processing takes place in the left whereas more global processing takes place in the right hemisphere. Due to the differences in processing information, the two hemispheres share equal importance in learning. Thus, utilization of both the left and
right mode techniques promotes more meaningful learning. Research on right and left brain hemispheres produce the following findings:

1. The two halves of the brain process information differently
2. Both hemispheres are equally important in terms of whole brain functions
3. Individuals rely more on one information processing mode than the other especially when they approach new learning (Bogen, 1969,1975)

Although the left and right sides of the brain are equally important, each side owns its own unique characteristics. Students with a left-brain preference for learning prefer an analytic, systematic, sequential, and looking-at-the-parts approach to learning new material; students with a right-brain preference for learning prefer a global, visual, intuitive, and whole-picture approach to learning new material.

A person’s dominant hemisphere is usually the one that processes incoming information, and the less dominant hemisphere can be strengthened through practice. If we want to help our children to learn the best of their abilities, it will naturally help for us to know which their dominant hemispheres are, and which their less dominant ones are. Armed with this knowledge, students can be taught new information in a way that is best received by their dominant hemispheres, and then the educators can review or practice that information in ways that involve their less dominant hemispheres. Doing this will strengthen the connection between hemispheres and improve the children’s ability to do well with learning. An instructional model is therefore required that aids teachers in designing units of study that address both hemispheres of students.

1.1.3 4MAT (4 Mode Application Techniques) System of Instructional Design

An understanding of the ways students learn is the door to educational improvement. In order to improve the performance of all types of learners, McCarthy developed the 4MAT System of Instructional Design in 1972 to assist teachers in their instruction based on differences in the way people learn. This Instructional Design provides a systematic approach to organizing and delivering instruction that addresses the learning styles and hemispheric preferences of the students. 4MAT System of Instructional Design consists of four quadrants each of which represents one of the four major learning styles. By superimposing right and left hemispheric preferences on each of the four quadrants, eight step cycle is formed. Right mode or left mode
Instructional strategies are assigned to each of the eight steps. According to 4MAT, if the teacher follows the cycle, the learning styles and hemispheric preference of each individual would be addressed at least one-fourth of the instructional time. During other parts of the cycle, the learner would be “stretched”, learning other ways to solve problems.

The 4MAT System was developed by Dr. Bernice McCarthy by combining the Kolb learning theory with other learning theories. It is based on the supposition that learning occurs best by passing through the four quadrants of the learning cycle. In this cycle, immediate experience creates a need for learning, which transfers to reflective observation of the experience. Reflective observation is followed by the introduction of concepts to integrate the immediate experience into what is known. After integration, testing is induced and, because this action results in new experiences, the cycle is repeated. The cycle can be thought of as answering the various questions associated with “Why?”, “What?”, “How?” and “What If?” Movement around the learning cycle can be accomplished by choosing appropriate learning activities which address the four different Learning Styles. Most learning activities can be intuitively placed in a particular quadrant.

There are four quadrants of learning in 4MAT. By examining the primary characteristics in each quadrant, the role shifts of teachers and learners become apparent. Each quadrant has a different emphasis. Quadrant One’s emphasis is on meaning, or how the material to be learned is connected to learners’ immediate lives. The connect portion of each lesson’s concept would intellectually tap each student’s schema for comprehending a concept. Quadrant Two’s emphasis is on content and curriculum and the importance of delivering instruction through an integrated approach. Quadrant Three addresses the usefulness of learning in the lives of the learners both in and out of school—it emphasizes the transferability of learning. Quadrant Four encompasses creativity, how the learner adds to the original learning in new and unique ways. When these quadrants are put together, they make up a complete developmental learning cycle, moving from subjective knowing to objective knowing to integrated knowing.

The different ways people prefer to learn can affect their success in what they do. Therefore, knowing learning preferences can make a significant difference in academic achievement. Using the 4MAT System allows all learners to be comfortable
in their preferred learning styles and brain processing mode and yet challenges all to learn in new ways (McCarthy, 1990).

1.1.4 Importance of Physics learning

Physics is the science that attempts to describe how nature works using the language of Mathematics. It is the oldest academic discipline, and the most widely respected. It is the language of innovation and advancement. It is often considered the most fundamental of all the natural sciences and its theories attempt to describe the behaviour of the smallest building blocks of matter, light, the Universe and everything in between. Physical theories have allowed us to obtain a greater grasp of the Universe we live in. It is the theories of Physics that provide us with some of our deepest notions of Space, Time, Matter and Energy. Physical theories allow us to conceptualize the workings of the building blocks of all matter. These are things we would never be able to experience in everyday life. At the other extreme, the theories of cosmology tell us how the Universe began and how it could possibly end. Again this is an example of Physics going beyond the limits of our experience to describe the space we live in. The theories of Physics are constantly tested against experimental evidence. As such, physical theories give us relatively concrete conceptions of notions beyond our everyday experience.

The knowledge of Physics is essential for everybody because of its immense value in our everyday life. Physics generates fundamental knowledge required for technological advancement, it extends and advances our understanding of other disciplines and it contributes to our technological infrastructure. The purpose of Physics teaching in secondary school enables the student, not only to develop the skills like systematic observation, logical thinking, reasoning, drawing conclusions but also making right decisions. In Physics curriculum, more emphasis is put on scientific method and attempt is made to develop scientific attitude and scientific temper in students. The motivating force behind the study of Physics and its application must be the desire of the student eventually to be a responsible person in the society, to understand the world around and to enrich the life of the people he is associated with.
1.2 Need and Significance of the Study

Decades ago, teachers had the assumption that the quality of learning depended solely on the expertise of the information giver, the teacher. With this premise, greater emphasis was on the improvement of teachers and their knowledge of instructions: how to teach a course. Later on, this paradigm shifted to the assumption that learning depended on the student’s frame of mind; thus focus was turned on the creation of a conducive learning environment and learning communities. Such environment gave the students opportunities to a) seek new knowledge and make new discoveries, b) master new skills for dynamism, c) ask questions so that they would improve, and d) perfect old skills needed for life long learning.

Such environment also gives opportunities for students to explore the subject matter with the teacher. The teacher and the students become co-learners and collaborators in search of new knowledge; students are heard and they receive answers to their queries. Thus teachers need to come together to talk about how they can understand and teach students better using the modalities which facilitate the latter to learn more (Learning Styles) and allow them to utilize their preferred way of expressing their knowledge about something. Even though learning activities are provided in the classroom according to the ability level of students, each student perceives and processes these activities in their own preferred ways. These preferences comprise each individual’s unique learning styles.

According to Junko (1998), learners having different learning style preferences would behave differently in the way they perceive, interact, and respond to the learning environment. Since learners differ in their preferences to certain learning styles, it will be important for teachers to examine the variations in their students on the features of their learning styles, because the information about learner’s preference can help teachers become more sensitive to the differences students bring to the classroom (Felder and Spurlin, 2005). Adjustments can then be made to accommodate the students’ varied needs.

Serious mismatches may occur between the learning styles of students in a class and the teaching style of the instructor (Felder and Silverman, 1988; Lawrence, 1993; Oxford et al., 1991; Schmeck, 1988), with unfortunate potential consequences. The students tend to be bored and inattentive in class, do poorly on tests, get
discouraged about the course, and may conclude that they are not good at the subject of the course and give up (Felder and Silverman, 1988; Goldleski, 1984; Oxford et al., 1991; Smith and Renzulli, 1984). Instructors, confronted by low test grades, unresponsive or hostile classes, poor attendance, and drop outs, may become overly critical of their students or begin to question their own competence as teachers. Oflaz and Turunc (2012) in their study suggests that by finding out the learning styles of the students and giving activities according to them, the teacher might improve the efficiency of his or her own teaching and increase the success rate. By targeting all learning styles and forming groups with students who have different learning styles, the teacher is also able to help the students develop their less dominant styles.

The concept of learning styles will challenge teachers to rethink of their methods to improve students’ academic achievement. As Guild and Garger (1985) assert, effective educational decisions and practices must derive from an understanding of the ways that individuals learn. Teachers should be made aware of the learning style patterns their students bring to the classroom. By understanding the connection between their methods of teaching and the ways their students learn, they can accumulate a general profile of their class and then orient their teaching to meet the needs of their students.

Most people have a preferred (dominant) hemisphere, and this preference affects personality, abilities and learning style. Hemispheric preference is largely a matter of processing style. Just as some people prefer more visual than auditory information when learning, people with strong but opposite hemispheric preferences will interact and interpret their worlds differently. Hemispheric preference runs the gamut from neutral (no preference) to strongly left or right. Those who prefer left hemisphere tend to be more verbal, analytical and able to solve problems. Right hemisphere preferred individuals paint and draws well, are good at math, and deal with the visual world more easily than with the verbal (Springer and Duetsch, 1998).

Research has demonstrated that students are capable of mastering new skills if they are taught through instructional methods that complement their hemispheric preference (Boyle and Dunn, 1998; Dunn, Sklar, Beaudry and Bruno, 1990). Several studies have found that students taught through methods that matched their hemispheric styles achieved statistically significant higher test scores than when they were taught through other teaching methods (Brennan, 1984; Dunn, Sklar, Beaudry
and Bruno, 1990; Jarsonbeck, 1984). Excellence and higher-order thinking demand that we honour both sides of the brain, teaching interactively with hands-on, real-life, messy problem solving. Learners speak in words, signs, symbols, movement, and through music. Unfortunately, however, teachers persist in lecturing and using logical, sequential problem solving most of the time. To foster a more whole-brained scholastic experience, teachers should use instruction techniques that connect with both sides of the brain.

The difference in Learning Styles and Preferences for the Hemisphere of the learners in any classroom necessitates a differentiated approach to instruction at all school levels and in all areas of learning. So the curricula, methods of teaching, human and material resources and other things in any scheme of education and institutional set up should be organized in a close tune with these individual differences.

4MAT system of Instructional Design which is an eight-step cycle of instruction that combines four Learning Style types and students' preferences for right-brain or left-brain modes of learning can guide instructors in planning teaching strategies to meet students' diverse learning needs. Each of the eight steps of the system emphasizes one of the learning types and alternatives from right- to left-mode information processing. Students with different learning styles can use 4MAT to engage their whole brain. According to Huitt (2000), student learning can be enhanced by using 4MAT System of instruction. Moreover, he stated that the 4MAT System can engage higher order thinking in students throughout the lesson. This instructional design can aid teachers in meeting individual needs of learners in their classroom and can be used as a guide in the development of their lessons and units of study.

So many studies were conducted on 4MAT system of Instructional Design and its effect on student attitude, motivation, interest and achievement in various disciplines. Studies on Learning Styles and Hemispheric Preferences are also conducted in many countries. No studies were conducted to find the effect of 4MAT system of Instructional Design on Learning Styles and Hemispheric Preferences in Kerala. Moreover, Physics is a Science that has greater difficulty in understanding by the students; this difficulty is evident in the low rate adoption of this discipline in schools at different educational levels where it is taught. Thus the investigator made
concerted efforts to study the effectiveness of 4MAT system of Instructional Design on Learning Styles, Hemispheric Preferences and Achievement in Physics of students at Secondary level.

The 4MAT is a direct instruction approach to teaching that utilizes research on brain lateralization dominance and learning style to identify specific instructional events that will be attractive to a specific type of learner. According to Bernice McCarthy (1996), there are four major learning styles, each of which asks different questions and displays different strengths during the learning process. The four major learners (Imaginative or Innovative, Analytic, Common Sense and Dynamic) can use 4MAT to engage their whole brain. Learners use their most comfortable style while being challenged to function in less comfortable modes. The student who has the flexibility to move easily from one mode to another to fit the requirements of the situation is at a definite advantage over those who limit themselves to only one style of thinking and learning.

The students at Secondary level have different Learning Styles and Hemispheric Preferences. This should come to the mind of the teacher while teaching. Teachers should design their instructional methods to connect with all four learning styles, using various combinations of experience, reflection, conceptualization, and experimentation. It is hoped that the results of the present study will give teachers and trainers a template for designing more effective instruction. 4MAT System of Instructional Design enhances four modes of learning that all learners need to succeed in learning. By designing instruction using 4MAT, instructors engage a wider diversity of students and, in the process, develop a full range of learning skills in all learners. This system also makes the inclusion of cooperative learning activities easy by telling the teacher exactly when the activities designed will be the most useful in the unit.

While using 4MAT System of Instructional Design, the learner has the flexibility to move easily from one mode to another to fit the requirements of the situation. Thus a student can practice three other learning styles and can become proficient in all these styles. Thus as the instructional design tool, 4MAT provides a systematic way to ensure thinking and learning for all learners. The use of this instructional design can help the secondary school students to learn more meaningfully and effectively the content of Physics which is usually abstract in
nature. This will also help the young learners to develop an interest in learning Physics.

Teachers can use the 4MAT System of Instructional Design to improve their instructional designs by employing diverse strategies in a cycle of learning. Use of 4MAT System of Instructional Design should enable teachers to develop activities that help students to refine, extend, and perform their learning. It is possible to engage students in class activities that provide them opportunities to work in small groups to produce and share their own learning. These activities will help the students feel more comfortable with the material and result in their being more self-directed and “owning” the content. 4MAT could provide the teacher the needed structure to plan instruction in a more linear fashion and facilitated a more focused “flow” for course content.

1.3 Statement of the Problem

Pupils have major/different learning styles and hemispheric (right – mode / left – mode) processing preferences. Teachers should use multiple instructional strategies to utilise these preferences to benefit teaching and learning. Since the present study aims to test the effectiveness of 4MAT System of Instructional Design on Learning Styles, Hemispheric Preferences and Achievement in Physics of students at secondary level, the study is entitled as “EFFECTIVENESS OF 4MAT SYSTEM OF INSTRUCTIONAL DESIGN ON LEARNING STYLES, HEMISPHERIC PREFERENCES AND ACHIEVEMENT IN PHYSICS OF STUDENTS AT SECONDARY LEVEL”.

1.4 Operational Definitions of Key Terms

Effectiveness

The extent to which an intervention, when used under ordinary circumstances, brings about a desired effect (Cooper, 2008).

Effectiveness in this study is conceived not only in terms of improvement in academic achievement but also in terms of Learning Styles and Hemispheric Preferences. It refers to the desired change in the learners’ behaviour because of the experimental intervention.
4MAT System of Instructional Design

4MAT (4 Mode Application Techniques) System of Instructional Design is the use of the learner’s “natural learning cycle” in the classroom (McCarthy, 1996). It is an eight-step cycle of instruction that combines four Learning Style types and students' preferences for right-brain or left-brain modes of learning, which can guide instructors in planning teaching strategies to meet students’ diverse learning needs. There are eight steps in this system. Each of the eight steps of the system emphasizes one of the learning types and alternatives from right- to left-mode information processing.

Learning Styles

McCarthy (2000) described Learning Styles as the individual’s perception and use of the knowledge.

In the present study, the investigator detailed the learning styles as suggested by McCarthy. The four Learning Styles according to McCarthy are: (1) Imaginative (Innovative); (2) Analytic; (3) Common Sense; and (4) Dynamic.

Hemispheric Preferences

Hemispheric Preferences means the preference for the left or right hemispheric mode of information processing. It is the preference by an individual to use one of the hemispheres of the brain (Operational Definition)

Achievement in Physics

Achievement refers to the performance in school or college in a standardized series of educational tests. The term is used more generally to describe performance in the subjects of the curriculum (Page, Thomas, and Marshall, 1978).

For the present study, Achievement in Physics is conceived as the total score that will be obtained by an individual in the test constructed and standardized by the investigator in Physics for the students at Secondary level covering the objectives/domains namely, Knowledge, Process Skills, Creativity, Application and Attitude.
**Students at Secondary Level**

In the present study, students at Secondary level refer to students who are studying in VIII, IX and X classes in Kerala State. This includes students in both the Private and Government institutions where Boys and Girls are in the age of 13-16 years. (Operational Definition)

**1.5 Hypotheses of the Study**

The hypotheses formulated for the study are:

1. The students at Secondary Level have different Learning Styles.
2. The students at Secondary Level have different Hemispheric Preferences.
3. Students in different Learning Style categories have different Hemispheric Preferences.
4. There will be significant difference in the Learning Styles of students taught using 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.
5. There will be significant difference in the Hemispheric Preferences of students taught using 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.
6. There will be significant difference in the Learning Styles of students before and after the treatment using 4MAT System of Instructional Design for the total sample and the relevant subsamples.
7. There will be significant difference in the Hemispheric Preferences of students before and after the treatment using 4MAT System of Instructional Design for the total sample and the relevant subsamples.
8. There will be significant difference in the Means of scores on Achievement in Physics of the students exposed to 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.
9. There will be significant difference in the Means of scores on Achievement in Physics of the students exposed to 4MAT System of Instructional Design and Activity Oriented Method with respect to their Learning Styles.
10. There will be significant difference in the Means of scores on Achievement in Physics of the students exposed to 4MAT System of Instructional Design and Activity Oriented Method with respect to their Hemispheric Preferences.

11. There will be significant difference in the Means of scores on Achievement in Physics of the students exposed to 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples with respect to different objectives/domains.

12. There will be significant difference in the effectiveness of 4MAT System of Instructional Design over Activity Oriented Method on Achievement in Physics of the students for the subsamples based on Gender and Type of School Management.

13. There will be significant difference in the Means of post-test and delayed post-test scores of students taught using 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.

1.6 Objectives of the Study

The objectives of the present study are:

1. To identify the Learning Styles of students at Secondary level.

2. To identify the Hemispheric Preferences of students at Secondary level.

3. To identify the Hemispheric Preferences of students in different Learning Style categories.

4. To compare the Learning Styles of students taught using 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.

5. To compare the Hemispheric Preferences of students taught using 4MAT System of Instructional Design and Activity Oriented Method for the total sample and the relevant subsamples.

6. To test the effectiveness of 4MAT System of Instructional Design on Learning Styles of students at Secondary level for the total sample and the relevant subsamples.
7. To test the effectiveness of 4MAT System of Instructional Design on Hemispheric Preferences of students at Secondary level for the total sample and the relevant subsamples.

8. To test the effectiveness of 4MAT System of Instructional Design on Achievement in Physics of students at Secondary level for the total sample and the relevant subsamples.

9. To test the effectiveness of 4MAT System of Instructional Design on Achievement in Physics of students at Secondary level with respect to their Learning styles.

10. To test the effectiveness of 4MAT System of Instructional Design on Achievement in Physics of students at Secondary level with respect to their Hemispheric Preferences.

11. To test the effectiveness of 4MAT System of Instructional Design on Achievement in Physics of students at Secondary level for the total sample and the relevant subsamples with respect to different objectives/domains.

12. To compare the effectiveness of 4MAT System of Instructional Design over Activity Oriented Method on Achievement in Physics of students at Secondary level for the subsamples based on Gender and Type of School Management.

13. To test the effectiveness of 4MAT System of Instructional Design on Retention of Achievement in Physics of students at Secondary level compared to Activity Oriented Method for the total sample and the relevant subsamples.

1.7 Methodology in Brief

Method used

Experimental method was used for the study as it was indented to test the effectiveness of 4MAT System of Instructional Design on Learning Styles, Hemispheric Preferences and Achievement in Physics of students at Secondary level. The design selected was Pre-Test - Post-Test Non Equivalent Group Design.

Variables of the study

The conditions or characteristics that the experimenter manipulates, controls or observes are called variables. In the present study, 4MAT System of Instructional
Design and Activity Oriented Method are the independent variables and Learning Styles, Hemispheric Preferences and Achievement in Physics are the dependent variables.

**Population of the study**

The population of the study consists of Secondary school students studying in the Kerala State Syllabus schools.

**Sample selected**

For the study, the sample consists of 248 students of class IX from Government and Aided Schools. The samples were selected using stratified random sampling technique giving due weightage to Gender and Type of School Management.

**Tools used**

The investigator used the following tools for the collection of necessary data required for the study.

1. Lesson Transcripts based on McCarthy’s 4MAT System of Instructional Design prepared by the investigator.
2. Lesson Transcripts based on Activity Oriented Method prepared by the investigator.
3. Learning Style Inventory prepared and standardized by the investigator.
4. SOLAT (Style of Learning and Thinking) by Dr. D. Venkataraman (1994).
5. An Achievement Test in Physics (constructed and standardized by the investigator) for the students at secondary level considering the objectives/domains
   a) Knowledge
   b) Process skills
   c) Creativity
   d) Application
   e) Attitude
Two schools from Kottayam District were selected for the experiment, giving due weightage to Gender and Type of School Management. The sample of the experiment consisted of 248 students of Standard IX from six divisions (two divisions from the Government School and four divisions from the Aided School). Of these, three divisions (two from Aided and one from Government) were randomly taken as experimental group and the other three divisions (two from Aided and one from Government) were randomly taken as the control group. The experimental group was taught using 4MAT System of Instructional Design and the control group by Activity Oriented Method.

The investigator herself conducted classes for both the groups. Before treatment, the investigator identified and compared the Learning Styles (using the Learning Style Inventory) and Hemispheric Preferences (using SOLAT) of the students in the experimental and control groups. The investigator also compared the Achievement in Physics of students in the experimental and control groups by administering an Achievement test in Physics. After the treatment, again the Learning Styles, Hemispheric Preferences and Achievement in Physics of the students in the experimental and control groups were compared by administering the same tests which were used as pre-tests. In addition to that, a delayed post-test was also employed to both the groups about one month after the completion of the experiment.

1.8 Statistical Techniques used

The following Statistical Techniques were used for analysing the data.

a) Basic statistical techniques.

b) Chi-Square Test

c) Stuart-Maxwell Test

d) Two tailed test of significance of difference between Means.

e) Analysis of Co-Variance

f) Two-way Analysis of Variance

g) Duncan’s Range Test
1.9 Scope of the Study

The present study was intended to find the effectiveness of 4MAT System of Instructional Design on Learning Styles, Hemispheric Preferences and Achievement in Physics of students at Secondary level. The study is a step to prove the usefulness of teaching based on individual preference of Learning Styles and Hemispheres. The 4MAT System of Instructional Design is an answer to the problem faced by teachers in catering the individual students’ needs and interests. It offers a way to make the learning process active and enjoyable for all types of learners. Therefore the learning process is improved and the performance of students is enhanced.

The study will throw light on the understanding of teachers and parents on individual learning styles and brain dominance processing preferences. It may also provide useful information about the application of 4MAT System of Instructional Design at Secondary level to experts, administrators and those who are concerned and interested in the education of children. This instructional Design will serve as a reminder to teachers that students should be able to use their knowledge and skills in the real world, to think in new and different ways, and especially to recognize that their 4MAT experiences were practice for real life.

1.10 Limitations and Delimitations of the Study

The limitations of the present study are listed as follows:

1. The sample for the study consisted of 248 students only because of practical difficulties in conducting the experimental study of experimental group-control group pre test-post test design.
2. Due to practical difficulties, seventeen lesson transcripts on two units could only be prepared for the treatment.
3. The investigator selected classroom intact groups for experimenting, as the one-to-one equalized group was not possible practically.

The delimitations of the study are listed as follows.

1. The study was confined to schools in Kottayam District.
2. The study was delimited to students of standard IX studying in Kerala state syllabus.
3. The effectiveness of 4MAT System of Instructional Design on Achievement in only one subject, i.e. Physics is tested.
4. Only two attribute variables, Gender and Type of Management of School were selected for the study.

Despite the above mentioned facts, all possible attempts have been made to make the study as valid and reliable as possible. It is hoped that the results of the present study would be helpful in finding new frontiers in the field of education.

1.10 Organization of the Report

The report has been presented in Six Chapters.

Chapter I, the introductory chapter presents a brief Introduction about the variables selected for the study, Need and Significance, Statement of the problem, Definition of Key terms, Hypotheses of the study, Objectives of the study, Methodology in brief, Tools used, a brief description of the Scope of the study, Limitations and Delimitations of the study and Organization of the report.

Chapter II gives the theoretical background of 4MAT System of Instructional Design.

Chapter III presents a detailed review of studies related to the variables 4MAT System of Instructional Design, Learning Styles, Hemispheric Preferences and Achievement in Physics.

Chapter IV, the Methodology chapter gives description of the Method adopted, Design of the study, Description of tools used, Sample selected for the study, Data Collection Procedure and Statistical Techniques used for the study.

Chapter V gives a detailed Analysis and Interpretation of the data collected.

Chapter VI contains Summary of the study, Findings and Major conclusions of the study together with Educational Implications and Some Suggestions for Further Research.