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Effectiveness of Mind Mapping Technique in Teaching Science to Secondary School Students in Relation to Their Academic Achievement

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ABSTRACT

What is science and how does it grow are the basic questions which all students of science must understand. Since the very dawn of civilization, man was curious to know about the things around him. The curiosity of man to know about nature and unveil its mysteries led to establishment of certain knowledge based upon facts. He also tried to understand its laws and utilize them to his daily life. Genius persons, by their persistent efforts, careful experimentation and exact reasoning have collected a mass of information. So the present study shows that how mind mapping techniques affect the students' achievement.

Keywords : Mind Mapping, Teaching, Scoence, Techniques, Secondary School Students, Academic Achievement

I. INTRODUCTION

1.1 Concept of Science

The word science comes from the Latin **"Scientia",** meaning knowledge. According to **Webster** new collegiate dictionary, the definition of science is "knowledge attained through study or practice", or "knowledge covering general truths of the operation of general laws, as obtained and tested through scientific method and concern with the physical world".

Science refers to a system of acquiring knowledge. This system uses observation and experimentation to describe and explain natural phenomena. The term science also refers to the organized body of knowledge people have gained using that system. Less formally, the word science often describes any systematic field of study or the knowledge gained from it. Concepts are the basic units of all types of learning & the simplest learning unit with meaning in a scientific discipline is represented by scientific concepts. The concepts are the ways by which facts & experiences can be integrated & are remain impressed in the mind much longer than facts.

Concepts differ from facts at one extreme & from theories or conceptual schemes at the other. Facts outside concepts may be regarded as blind & concepts without facts are useless.

According to **Gagne (1970)** :- "Concepts & principles may be related to the world & to each other in a hierarchical fashion .If a child does not learn concepts & principles that are lower in hierarchy ,the learning of those higher in hierarchy becomes difficult or impossible."

Bruner (1975) opined that attained a concepts is beneficial to the individual in several ways in identifying objects around him, in reducing the necessity of constant learning & in reducing the complexity of environment.
According to **Well & Joyce (1978)**, helping children learn concepts & teaching them how to learn concepts is a fundamental purpose of schooling.

Today's education is expected to produce citizens who can deal with words, concepts & scientific symbols ,essential for a successful life in the highly technological modern world. The stress give to the conceptual structure of science will enable the pupil to recognize & understand better manner. This will facilitate the students to be in a better position in the acquisition of scientific knowledge.

Proper understanding of the basic concepts in a particular subjects & having the ability to apply these concepts in different situation are important factors determining a pupil's achievement in that particular subjects.

Chemistry teachers, like other science teachers, must pay special attention to the development of concepts in pupils, through direct & concrete sensory experiences as far as possible.

1.2 Purpose of Science

Perhaps the most general description is that the purpose of science is to procedure is useful models of reality. Most scientific investigations are use some from the scientific method. Science as defined above is sometimes called pure science to differentiate it from applied science, which is the application of research to human needs. Field of science is commonly classified along to major lines. Natural science, the study of the natural world, and Social science, the systematic study has the human behavior and society.

The National Policy on Education (1986) makes it clear that "Science education must be strengthened as to develop in the child some well- defined abilities & values like spirit of enquiry, creativity, objectivity, courage to question & aesthetic sensitivity".

Science education in school curriculum especially at secondary school stage is necessity. Due to rapid advancement in the field of science & technology, new inventions & discoveries are made every day & some of these have great impact on society. Science education helps the individual to have a balanced view about the new advancement in the field of science.

Science education gives training to individual in scientific method & helps to develop a scientific attitude & inculcates in them a spirit for scientific enquiry. Science education provides unique training in truth imparts the capacity to know the unknown & improves the strength to face failures. There are highly useful & transferable to other life situation also.

1.3 Different Fields of Science

This is just a particle listen of some of the many, many different possible fields of study with in science. Many of the field listen here overlap to some degree with one or more other areas such as Biology, Physics, Chemistry.

There is no one definition of science which is universally accepted. There are, perhaps, as many definitions of science as there are scientists. We shall discuss some of the definitions in order to understand the nature of science

Science is a cumulative and endless series of empirical observations which result in the formation of concepts and theories being subject to modification in the light of further empirical observations. Science is both a body of knowledge and process of acquiring it.

Science is an accumulated and systematized learning, in general usage restricted to natural phenomenon. The progress of science is marked not only by an accumulation of fact, but by the emergence of scientific method and of the scientific attitude.

From the these two definitions three basic principles of the nature of the science can be identified (1) an accumulated and systematized body of knowledge , (2) the scientific method of inquiry , and (3) the scientific attitudes. The first point indicates the PRODUCT of science, while second and the third points indicate the PROCESS of science. In other words, science is both a product and process.

Henri Poincare explains the idea this way: "Science is built of facts as a house is built of stones; but an accumulation of facts is no more a science than a heap of stones". The true nature of science is revealed more in the way it is sought rather than in what is found, although the two efforts can't be truly separated. In another way, it could be said that science is more a verb than it is a noun. Science is the cyclic enterprise consisting of the formulation of model or explanation from facts which in turn predict the occurrence of unsuspected facts. If these new facts are indeed found, the value of the model is increased. If the fact are not found, the model is changed, and a new model is suggested to predict new facts and so on. Science can also be defined in terms of what scientists do or in other words, "Science is what scientist does". But in order to understand this definition of science we have to understand this definition of science we have to understand how scientists work. There are at least three basic things that the scientists do – They make descriptions, explanations and predictions. In other

words, Science can be defined as 'the process by which we increase and refine understanding of ourselves and of the universe through continuous observation, experimentation, application and verification'.

1.4 Main Characteristics of the Process of Science

The major items in the process of science as advocated by the National science teachers associations, Washington, are as follows:

- ✓ Science proceeds on the assumption, based on centuries of experience, that the universe is not capricious.
- ✓ Science knowledge is based on observation of samples of matter that are accessible to public investigation in contrast to purely private inspection.
- ✓ Science proceeds in a piecemeal manner, even though it also aims at achieving a systematic and comprehensive understanding of various sectors or aspects of nature.
- ✓ Science is not, and probably never will be, a finished enterprise, and there remains very much more to be discovered about how things in the universe behave and how they are interrelated.
- ✓ Measurement is an important feature of most branches of modern science because the formation as well as the establishment of laws is facilitated through the development of quantitative distinctions.

1.5 The Structure of Science

The structure of science can be compared to the framework of a building under construction. A framework of a building consists of foundation, vertical pillars and horizontal beams. The foundation of the framework is comparable to broad generalizations and principals of science. The vertical pillars to the theories and the horizontal beams to the methods and process of science. The facts are comparable to building materials i.e. stone, bricks and concrete etc. In this analogy the vertical pillars and the horizontal beams of science is subject to alteration on the basis of empirical tests. It should be noted that this analogy of a building under construction is to facilitate understanding of the structure of science. Science is obviously not a building under construction in its literal sense.

II. REVIEW OF LITERATURE

Cain(2001/2002)at Newchurch Community Primary School in Warrington showed a variety of improvements in pupils learning after Mind Mapping was introduced. This evidence includes improved concentration, staying on task for longer periods of time, improved questioning and answering during class discussions and improved independence.

Goodnough and Woods (2002) discovered that students perceived Mind Mapping as a fun, interesting and motivating approach to learning. Several students attributed the fun aspect to the opportunity to be creative when creating Mind Maps through lots of choice in colour, symbols, key words and design.

Karen Goodnough and Robin Long(2002)conducted a study on Mind Mapping: A Graphic Organizer for the Pedagogical Toolbox and concluded that Mind Mapping offers an alternative means for students to share their knowledge and understanding. It caters to both the verbal-linguistic and visual-spatial intelligences through its combination of graphics, symbols and text. As such, it fosters expressive thinking in a way that is both fun and motivating for students.

Astrid Brinkmann (2003) conducted a study on Graphical Knowledge Display – Mind Mapping and Concept Mapping as Efficient Tools in Mathematics Education, and concluded thatBoth Mind Mapping and concept mapping may be effective tools to improve mathematics achievement. Teachers would need to decide which of the two methods they would want to use depending on the outcomes they want to achieve. He believes that the various positive learning effects of using the techniques should result in their growing usage in mathematics education.

Budd (2004) proves that Mind Mapping engages students in active learning. In particular, students with higher scores for a 'doing' learning style benefited from Mind Mapping activities.

Polsen (2003/2004) the majority of students emphasized the flexibility that Mind Mapping offered in their learning. In particular, they appreciated the creative aspects of the technique and the assistance it gave them

in understanding concepts and ideas. Improved confidence and more positive attitudes towards learning were also apparent.

Miriam Haskell (2005) conducted a study onMind-mapping helps children remember lessons and concluded that Mind Mapping is an effective tool for helping children remember important lessons.

Amila Wickramasinghe, Nimali Widanapathirana, Osuka Kuruppu, Isurujith Liyanage and Indika Karunathilake (2007) conducted a study on Effectivness of mind maps as a learning tool for medical students andthe researchers concluded that the Mind Mapping technique did not show any obvious advantage over other conventional study techniques as a short-term learning method for new students. Despite this, the majority of students in the relevant group perceived it as a useful learning tool. Given that the students were exposed to the technique for the first time, the initial results and the students' positive comments are encouraging for promoting the use of Mind Mapping as an effective self-learning tool. The researchers suggest that further studies should be undertaken to evaluate its effectiveness in retaining information in the long-term.

Abi-El-Mona and Adb-El-Khalick (2008) revealed that science students who used Mind Mapping achieved substantially higher gains in conceptual understanding and practical reasoning than students using conventional study techniques. The personal, student-created structure and nature of Mind Mapping allowed students of different achievement levels to apply it in ways that best corresponded with how they recall information and assimilate their understanding of content.

S. Thangarajathi (2008)conclude that Mind Mapping Technique is more effective than the Conventional Method. The Conventional Method can make improvement in achievement of the people to a certain extent. The Mind Mapping Technique is effective in teaching students irrespective of their sex, parental education and parental income.

Boyson(2009) Using Mind Mapping for lesson planning can help teachers identify a logical teaching route and increases recall of the subject matter. This can boost teaching confidence and facilitate the smooth running of lessons.

Gemma Boyson (2009)conducted a study onThe Use of Mind Mapping in Teaching and Learning.The teacher found Mind Mapping to be an effective method of note-making and arranging thoughts. While some students enjoyed the unique approach of Mind Mapping and the creativity it engendered, a sizeable proportion found the additional effort required to create a Mind Map to be a barrier to their learning. This reaction may have been different if more time was spent introducing and practicing the technique. The teacher suggests introducing Mind Mapping and other note-making methods to students at an early age as it may fit in well with young children's cognitive and writing skills development. It is also implied that Mind Mapping may be more appropriate for students to use for organising their own thoughts during revision, rather than note-taking in a lesson.

III. CONCEPT OF ATTITUDES

Scientific attitudes are the most important outcomes of science teaching. Though some people view the scientific attitudes as the by-products of teaching science, yet a majority of the people consider them as equally important as the knowledge aim. Science should be taught directly and systematically because developing scientific attitude has a number of characteristics features which distinguish it from other attitudes.

A man with scientific attitude:

- ✓ Is critical in observation and thought.
- ✓ Is open-minded.
- ✓ Respects other's points of view and is ready to change his decision on presentation of new and convincing evidence.
- ✓ Is curious to know more about the things around him. Wants to know 'Why', 'What' and 'How' of the things he observes.
- ✓ Is an objective in his approach to problem?
- ✓ Does not believe in superstitions and false beliefs.
- ✓ Believes in cause and effects relationship.
- ✓ Suspends judgment until suitable support is obtained.
- ✓ Is truthful in his observation and draws conclusion based on the accurate facts.
- ✓ Is unbiased and impartial in his judgments.

- ✓ Adopts a planned procedure in solving a problem.
- ✓ Believes that truth never changes, but his ideas of what is true may change as he gains better understanding of that truth.
- ✓ Accepts no conclusion as final or ultimate.
- ✓ Seeks to adopt various techniques and procedures to solve the problem.
- ✓ Select the most recent, authoritative and accurate evidence related to the problem.
- ✓ Seeks the facts and avoids exaggeration.

3.1 Development of Scientific Attitudes

This is the value monopolized by science which is transferable. The attitudes of a scientist involve critical observation, open-mindedness, suspended judgement, free from superstitions and false belief etc. The attitude once developed in the student proves useful in later life of the child.

Apart from this the teaching of science based on sound psychological footing. The principle of activity is the main bases of the teaching of science and satisfies the instincts of curiosity, creativeness and self-assertion, self-expression etc. of the pupils.

So, it is quite clear from the above discourse that a subject which is so valuable and psychologically based and so closely connected with our daily life, is justified to be included in the curriculum.

Science is the result of an intense struggle of human intellect and has wrested from nature not only her secrets but processes also which underlie them. It has emerged as almost a decisive force and its role in education needs to be adequately understood.

3.2 Correlation in Science

Correlation, as the word signifies, is the reciprocal relationship between various subjects of the curriculum. The child is interested to learn the things which are related to his experiences. They can't learn the various subjects in isolation. While teaching, say science, we can ill-afford to confine ourselves to this subject alone. How can we forget that other physical sciences have equal contribution to the field of biological studies? So, the correlation of different subjects is very essential for checking artificiality of treatment and for achieving unity of knowledge. It makes study easier, more interesting and natural.It develops knowledge by dove-tailing with each other the bits of similarities existing in the diversity of subjects and compounds them into such a complex whole which the mind of the child is willingly ready to accept.

In Basic Scheme of Education, correlation occupies the pivotal position and it is not the crafts that make the school basic but it is the correlation that makes it really basic. In this scheme, emphasis is laid not only on the correlation of one subjects with another but of education with life. The principle of correlation demands that various subjects contribute to the child's education in the manner and to extent that they help him to understand his environment better and carry out activities that have meaning for him. Correlation of general science will be discussed under the following headings:

- ✓ Correlation of science subjects with one another.
- ✓ Correlation of science with other school subjects.
- ✓ Correlation of science with social and physical environments.
- ✓ Correlation of science with medicine.
- ✓ Correlation of science with agriculture.
- ✓ Correlation of science with mathematics.
- ✓ Correlation of science with psychology.

IV. MIND MAPPING

Mind Maps were popularized by author and consultant, Tony Buzan. They use a two dimensional structure, instead of the list format conventionally used to take notes.

Mind Mapping is a useful technique that helps you learn more effectively, improves the way that you record information, and supports and enhances creative problem solving. By using Mind Maps, you can quickly identify and understand the structure of a subject. You can see the way that pieces of information fit together, as well as recording the raw facts contained in normal notes.

More than this, Mind Maps help you remember information, as they hold it in a format that your mind finds easy to recall and quick to review.Mind Maps are

more compact than conventional notes, often taking up one side of paper. This helps you to make associations easily, and generate new ideas. If you find out more information after you have drawn a Mind Map, then you can easily integrate it with little disruption.

More than this, Mind Mapping helps you break large projects or topics down into manageable chunks, so that you can plan effectively without getting overwhelmed and without forgetting something important.

A good Mind Map shows the "shape" of the subject, the relative importance of individual points, and the way in which facts relate to one another. This means that they're very quick to review, as you can often refresh information in your mind just by glancing at one. In this way, they can be effective mnemonics remembering the shape and structure of a Mind Map can give you the cues you need to remember the information within it. When created using colors and images or drawings, a Mind Map can even resemble a work of art!

4.1 Popularization of the term "Mind Map"

Buzan's specific approach, and the introduction of the term "mind map" arose during a 1974 BBC TV series he hosted, called *Use Your Head*. In this show, and companion book series, Buzan promoted his conception of radial tree, diagramming key words in a colorful, radiant, treelike structure. Buzan says the idea was inspired by Alfred Korzybski's general semantics as popularized in science fiction novels, such as those of Robert A. Heinlein and A. E. van Vogt. He argues that while "traditional" outlines force readers to scan left to right and top to bottom, readers actually tend to scan the entire page in a nonlinear fashion. Buzan's treatment also uses then popular assumptions about the functions of cerebral hemispheres in order to explain the claimed increased effectiveness of mind mapping over other forms of note making.

4.2 Mind Map Guidelines

Buzan suggests the following guidelines for creating mind maps:

- ✓ Start in the center with an image of the topic, using at least 3 colors.
- ✓ Use images, symbols, codes, and dimensions throughout your mind map.
- ✓ Select key words and print using upper or lower case letters.
- ✓ Each word/image is best alone and sitting on its own line.
- ✓ The lines should be connected, starting from the central image. The lines become thinner as they radiate out from the center.
- ✓ Make the lines the same length as the word/image they support.
- ✓ Use multiple colors throughout the mind map, for visual stimulation and also for encoding or grouping.
- ✓ Develop your own personal style of mind mapping.
- ✓ Use emphasis and show associations in your mind map.
- ✓ Keep the mind map clear by using radial hierarchy or outlines to embrace your branches.

4.3 Uses of Mind Maps

Mind Maps are useful for:

- ✓ Brainstorming – individually, and as a group.
- ✓ Summarizing information, and note taking.
- ✓ Consolidating information from different research sources.
- ✓ Thinking through complex problems.
- ✓ Presenting information in a format that shows the overall structure of your subject.
- ✓ Studying and memorizing information.

4.4 Drawing Basic Mind Maps

To draw a Mind Map, follow these steps:

- ✓ Write the title of the subject you're exploring in the center of the page and draw a circle around it.
- ✓ As you come across major subdivisions or subheadings of the topic (or important facts that relate to the subject) draw lines out from this circle. Label these lines with these subdivisions or subheadings.
- ✓ As you "burrow" into the subject and uncover another level of information (further subheadings, or individual facts) belonging to the subheadings, draw these as lines linked to the subheading lines.

- ✓ Then, for individual facts or ideas, draw lines out from the appropriate heading line and label them.
- ✓ As you come across new information, link it in to the Mind Map appropriately.

A complete Mind Map may have main topic lines radiating in all directions from the center. Sub-topics and facts will branch off these, like branches and twigs from the trunk of a tree. You don't need to worry about the structure you produce, as this will evolve of its own accord.

4.5 Science and Mind Maps

A mind maps in general is very useful in any teaching – learning process. Especially in teaching of science, the technique of using mind maps can create wonders in the output.Mind maps in science help in the following ways.

- ✓ Gathering and hold large amount of data.
- ✓ Encourage problem solving by seeing new creative pathways.
- ✓ Enable to increase one's retention.
- ✓ Achieve higher level of creativity, increased concentration and clear organization of thoughts.
- ✓ Improve mental abilities.
- ✓ Remember names, facts, figures, formulae etc. using memory technique.
- ✓ Recall what is learned during revision and summarization.

V. CONCLUSION

Mind Maps have proved to be a simple but vital aid to learning, and have amazing success in classrooms all over the world. Pupils and students of all ages, helping them understand course material, boost memory and recall, generate ideas, assists as a revision aid and help structure coursework. It can be used for all the levels of schooling.Mind mapping has been defined as 'visual, non-linear representations of ideas and their relationship. In simple terms, processing information verbally as well as pictorially helps learning by virtue of using more than one modality. The use of Mind Maps in teaching and learning is examined in three different ways:

- ✓ Mind Maps is use as a note making tool in developing the teacher's own subject knowledge.
- ✓ Mind Maps is presented information to students in lessons.
- ✓ Introducing Mind Mapping as a note making format for students.

From the perspective of the teacher, using Mind Mapping for planning brought about increased understanding of module objective, helped in identifying a logical teaching route and increased recall of the subject matter. Using Mind Maps improves recall of words more effectively than using lists.

Training should be given to teachers in this regard. Students should be encouraged to make Mind Maps on their own, for their learning purpose. Mind Maps help in association easily. They are helpful in summarizing information. Mind Mapping is enabling to increase retention power. It improves mental abilities. Mind Mapping may be used in the entire subjects to bring about better learning outcomes. School libraries should include books on Mind Maps in general, usage of mind maps, how to make effective Mind Maps etc. This will help the teachers in effective classroom teaching. This study has significant role in the teaching – learning process. It has been used in the classroom as a means to develop a student's individual knowledge based while promoting knowledge sharing. This technique is supported by the cognitive learning theory, which suggests that learning must be meaningful in order to link new knowledge with previous knowledge. This technique is used to encourage each student to prepare a 'mind map' of a particular concept or theme. This technique is helpful in the better academic achievement among students.

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