

Effectiveness of Mind Mapping Teaching Strategy in Unlocking the Cognitive Potential of Students in Basic Science and Technology in Secondary Schools in Ondo State, Nigeria

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ABSTRACT: The study identified the concept of Chemical Bonding in Junior Secondary School Basic Science and Technology Curriculum and examined the effectiveness of Mind Mapping Teaching Strategy (MMTS) to unlock the cognitive development of students in the concept of chemical bonding. Chemical bonding is a topic that requires critical and analytical thinking in which students' cognition needs to be developed for effective performance. In this study therefore, mind mapping was used as a teaching strategy to unlock students' cognition in chemical bonding. A pre-test post-test control group design was adopted with mind mapping teaching strategy being the treatment while the control group was exposed to lecture method. A total of 98 Junior Secondary School III (JSS III) students from two schools were randomly selected from Akoko North East Local Government Area of Ondo State, Nigeria to constitute the study sample. The choice of JSS III students was due to the fact that it is easier to mould and unlock students potentials especially the cognitive aspect when they are young vis-à-vis their formative years. The two intact classes were classified into experimental (MMTS= 48) and control group (LM = 50). A 20 item instrument tagged Chemical Bonding Achievement Test (CBAT) with reliability coefficient of $r = 0.78$, $p < 0.05$ was used to collect data. The question items consists of question on metacognition. The results showed that MMTS is more effective ($X = 15.64$) than lecture method ($X = 9.76$), $t = 9.90$, $p < 0.05$. The study concluded that Mind Mapping Teaching Strategy is a better approach to teach Basic Science and Technology (BST) as its potency is very clear at improving learners' critical and creative skills that will make them effective problem solvers.

KEYWORDS: Unlocking, cognitive development, potential, effectiveness, creative, problem solving

I. INTRODUCTION

The importance of science is anchored on chemistry as one of the basic science subjects for scientific development. Chemistry is one of the basic requirements for professional biological and technological courses such as medicine, pharmacy, computer and engineering courses. That may be why Okeke, (2005) reported that, Chemistry is one of the pivot subjects for technological development. This description and assertion indicate the significant position accorded to chemistry as veritable tool for sustainable science and technology development in which chemistry has contributed immensely to the betterment of the human condition in engineering, medicine and drug industries. It has been noticed generally by the researcher that there is a decline of interest for chemistry concepts among science students even at foundation level, that is, Junior Secondary School level during which Basic Science and Technology (BST) lessons are taught in our educational institutions in Nigeria, hence the need for a resourceful teaching strategy like Mind Mapping which should be adopted in teaching some concepts in chemistry. The adoption of Mind Maps in teaching has grown recently due to the benefits of using Mind Maps to learn and the availability of free online mind mapping software.

Teachers in Nigeria need to recognize the value of using Mind Maps to engage students, encourage creativity and most importantly, teaching how to learn rather than simply memorizing content. Mind maps have even been integrated into emerging teaching techniques such as the flipped classroom and design thinking. Childrens' brains develop most and faster in the first few years of their lives. Everything they hear or see engages their brain in different ways. Consequently, it is essential for parents and teachers to actively participate in every action in order to make sure that their brain develops and shapes in the right manner. Development stands for every change children experience during physical and mental growth. Both parents and teachers should have great concern and impact on how well their social, emotional, behavioural, thinking and communication abilities of their children are developed. Children at their young age are getting interested in building different shapes, patterns and colours. Specifically, drawing is the way they start to express themselves during the time they are growing and learning how to communicate. Logically, teachers should strive to implement teaching strategy that could widely help children in expressing themselves in the classroom, hence, the choice of Mind Mapping technique to teach chemical bonding in BST because, the topic involves drawing of structures of atoms which is one of the ways children start to express themselves through thinking and communicative abilities.

How Mind Mapping Helps Children's Cognitive : At a young age, children communicate more with images than words. While for the adults, it comes naturally to use words for communication, where children tend to express themselves in a more colourful way. Particularly, adults are inclined to use more of the left hemisphere of the brains, which is responsible for controlling the right side of the body and is associated with logical and analytical thinking. Children, on the other hand, tend to use the right hemisphere of their brains, which is responsible for controlling the left side of the body and is associated with artistic and creative thinking. Mind Mapping is a technique which has many advantages for intelligence development. This is important for children's development. Mind mapping stimulates using both left and right sides of the brain, as it involves using images and words at the same time, hence, its usefulness in teaching chemical bonding in BST in the Junior Secondary School. Therefore, Mind Mapping can be taught to children because it can help them develop and improve their verbal, logical and even visual abilities.

For children who are in the growing and developing stage in which they use the right side of their brain, Mind Mapping could be the ideal method for stimulating the left side of their brain. In the process of Mind Mapping, a drawing will come naturally for these children. In addition, since in mapping, they also use words in which children will have the possibility to learn how to connect their drawings with verbal expression. However, as a teacher, one should be aware that Mind Mapping would not make children intellectuals, but surely will make them attentive learners, creative thinkers and good problem solvers. With the use of words and images, Mind Mapping encourages the stimulation of children's senses and ability to think and solve problems.

How to Present First Mind Map in the Classroom : Introducing Mind Mapping to children should be an entertaining technique. The goal is not to give your pupils a complex and difficult central subject, because it is most likely that they will eventually reject mind mapping. The idea is to encourage them express themselves with worlds while using images and symbols. The type of the first map to choose for the students depends on the age of the students in your class. For example, mind mapping can be introduced to children at the age of 6 to 12 or 12+. However, the types of the maps can vary in structure or in subject, hence, the choice of Chemical Bonding in Basic Science and Technology in the Junior Secondary School. For children that are 6 to 12+ years, it is necessary to give them a mind map that will include colours, symbols and pictures. As a start, you can try to create a simple mind map with few connections. The fewer relationships you include in the map the better. The age range for JSS III students in Nigeria is between 12 – 13 years, hence, the need for the use of appropriate teaching strategy- Mind Mapping.

Theoretical Framework of Mind Mapping : The theoretical framework of this study is anchored on these three theories namely: constructivist theory, cognitive learning theory of Piaget (1956) and Vygotsky Social learning theory (1989). Constructivism is a theory that explains how knowledge is constructed in human beings when information is exposed to existing knowledge that had been developed by experiences. This theory assumes that human construct their own knowledge based on their existing knowledge. This construction of knowledge takes place within a context of social interaction and agreement (Hewson, 1992)

Piaget's cognitive theory on its own part is based on the work of Swiss development Psychologists Jean Piaget (1956). Piaget focuses on children's thinking process. According to Piaget (1970) knowledge is constructed in learner's mind through their interaction with the environment.

Piaget believes that there was a biological inevitability to how children developed (March, 2000). According to March, (2000), Piaget's work had some insight which are;

1. that children think differently related to their stage of development
2. that learning requires active involvement between children and environment
3. children construct their own cognitive structures

Vygotsky's Constructivists social learning theory : Vygotsky learning theory (1989) reasons that social interaction plays a fundamental role in the development of cognition. Individual development derives from social interactions within which cultural meanings are shared by the group and eventually internalized by the individuals. Hence, individual construct knowledge in transaction with the environment, and in the process, both the individual and the environment are transformed. Conclusively, cognitive theories are guides to this research. Ideas from Cognitive Psychologists will help the students to identify the developmental levels of each child, organize appropriate learning experiences to suit the child's age and learning ability.

To guide the study, two hypotheses were formulated namely;

1. there is no significant difference in the pre-test scores of students on the selected Basic Science Technology concept – Chemical Bonding, when exposed to Mind Mapping (MMTS) and Lecture Method (LM).
2. there is no significant difference in the cognitive development of students' vis-à-vis their academic performance when exposed to Mind Mapping Teaching Strategy after treatment.

II. METHODOLOGY

The study adopted a pre-test, post-test control group design. The population for the study consisted of all Junior Secondary School III (JSSIII) students in Akoko North East Local Government Area of Ondo State. From these, two schools were randomly selected and from which two intact classes of JSS III were chosen for the study. From the two intact JSS III classes selected, one was exposed to Mind Mapping Approach and the second one was taught using lecture method respectively. The period of administration was six weeks and the concept chosen was Chemical Bonding.

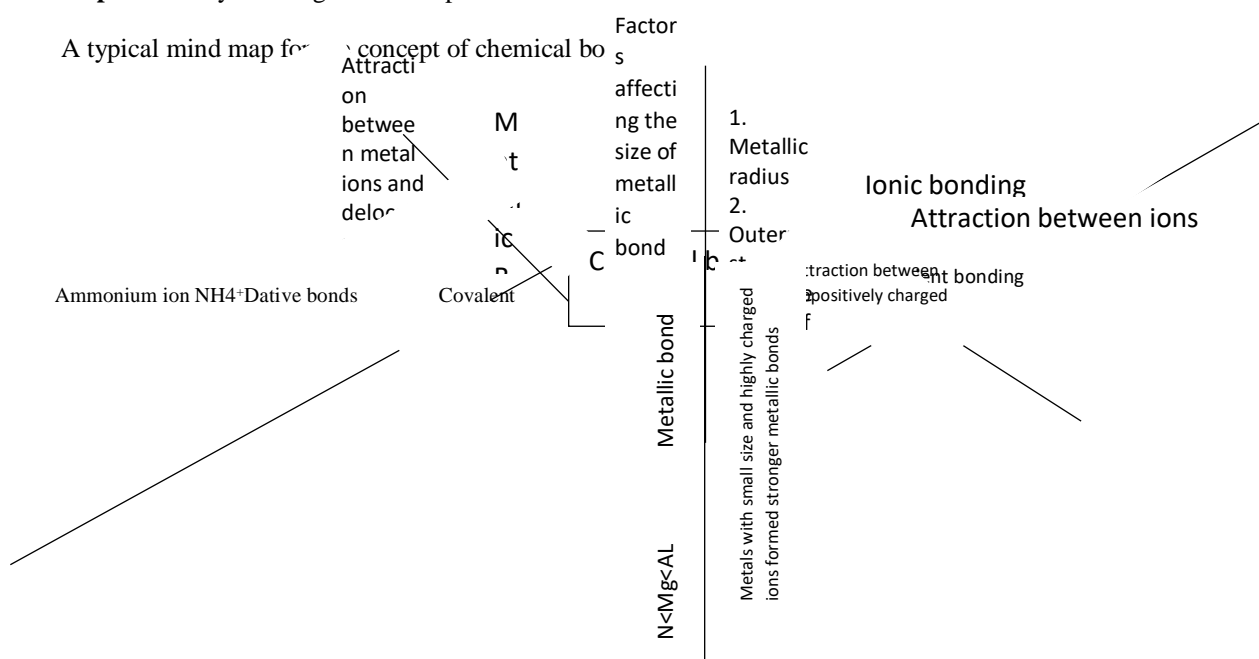
The Instrument and Administration : The instrument used for the study was Chemical Bonding Achievement Test (CBAT) which consisted of 20 item questions with reliability coefficient of $r = 0.78$, $p < 0.05$ was used to collect data.

Procedure for the Study : The first step was to identify the concept to be taught. Chemical Bonding was chosen by the researcher because it was observed that BST teachers usually teach only an integral part of the topic while neglecting some other important aspect such as Dative Bonding, Metallic bonding and factors affecting the strength of metallic Bond. This neglected aspect if well taught with a teaching strategy like Mind Mapping will unlock the cognitive development of BST students at JSS III level because at this stage (12 years +), students cognition can easily be developed for creative thinking which will make them good problems solvers. Mind Mapping helps students reignite their creativity, promoting ideas through association, and introducing visual and memorable approach to learning.

Method of Instruction : Development stands for every change children experience during their physical and mental growth. Children at a young age are more interested in constructing shapes, patterns and colours. Mind Mapping involves using images and words at the same time, hence, the use of this teaching strategy to unlock their cognitive potentials.

A typical Mind Map Lesson Plan

Step 1: Start by building a mind map as a class



If your students have used mind mapping before, they may recognize the format. If not, indicate the concept and discuss some of the benefits with them.

On the projector, the teacher could also have some examples on how students can use mind mapping in a class to take notes.

Step 2: from the above map, students are given assignments to draw their maps.

Step 3: Have students create a mind map for home work- assess pupils progression with some other topics and ask them to brainstorm ideas in the mind map

Step 4: Revision Mind Map : Create a revision mind map for a perfect understanding

Step 5: Mind map presentation : Students are to show how individual pieces of information are connected. This helps them comprehend and retain information more easily.

Step 6: Group assignments are given to students to encourage collaboration and social interaction among students.

Step 7: Evaluate / Exercise : Students are given exercises to help them break down the information into more manageable chunks. They can visualize points, make creative thinking and solve problems that arise from the map. Additional maps could be drawn in other topics.

Scoring Procedure : Each student was asked to develop a mind map showing the results of their findings. Upon completion, students within groups shared their maps with one another. Students are informed that they could revise and reconstruct their maps resulting from these comparison and discussions, after which the CBAT was administered.

III. RESULTS

Tables 1 and 2 present the results

Table 1: Difference between pre test scores of experimental and control group

| Groups | N | X | Std. Dev. | Df | tcal | Significance Level |
|--------------------------------|----|------|-----------|----|------|--------------------|
| Mind Mapping Teaching Strategy | 48 | 7.0 | 2.70 | 96 | 1.92 | Not significant |
| Lecture Method | 50 | 6.62 | 2.80 | | | |

Results from table 1 showed that there was no significant difference in the pretest scores of students exposed to Mind Mapping teaching strategy ($X = 7.0$) and Lecture Method ($X = 6.62$).

Table 2- Difference between post treatment scores of experimental and control group

| Groups | N | X | Std. Dev. | Df | tcal | Not significant |
|--------------------------------|----|-------|-----------|----|------|-----------------|
| Mind Mapping Teaching strategy | 48 | 15.64 | 2.89 | 96 | 9.90 | Significant |
| Lecture Method | 50 | 9.76 | 2.75 | | | |

$p < 0.05$

Table 2 shows that the mean score for the students in the Mind Mapping Teaching Strategy group ($X = 15.64$) was higher than that of the lecture method ($X = 9.76$) when the mean scores were subjected to t-test. It yielded a value of 9.90 which was significant at 0.05 level.

IV. DISCUSSION

The results showed that students in Mind Mapping Teaching Strategy group performed better ($X = 15.64$) than their counterparts in Lecture Method ($X = 9.76$) after treatment. This was evident in the result of the posttest in the MMTS group as stated above. The reason for the better performance of students in MMTS could be due to student's active construction and participation in the learning process, in which students were allowed to think and construct their own cognitive structures and interact with the environment. The result of this study is in agreement with the study of Okeke, (2001) who reported that Mind Mapping has been found to be used in facilitating meaningful learning as it helps students map a new concept with a familiar and relevant concept. Also, the results supported the assertion made by Ezenwa (2005), that Mind Mapping promotes meaningful learning rather than rote learning thereby making students retain learned concepts longer. Also, this study is in consonance with Adodo (2013) who reported in his study that Mind Mapping strategy helped to improve students' performance in Basic Science and Technology and should be employed in the classroom as a better approach to teach Basic Science and Technology (BST) as its potency is very clear at improving learners' critical thinking and creative skills.

V. CONCLUSION

In conclusion, Mind Mapping Teaching Strategy (MMTS) tends to be effective both in enhancing students' performance in BST and in developing and unlocking their cognitive development. This might be due to the fact that MMTS makes students to be attentive learners, creative thinkers and good problem solvers. With the use of words and images, mind mapping encourages the stimulation of children's sense and ability to think and solve problems.

There is the need for teachers therefore, to know that Mind Mapping is a technique that is used for intelligence development in children especially at the Junior Secondary School when children are still in the growing and developing stage. It is thus recommended that Junior Secondary School teachers should make use of Mind Mapping teaching strategy in teaching BST. Also, the MMTS which uses both constructivist and Piagetian theory can be used in curriculum materials and instructional strategies for teaching Basic Science & Technology in the Junior Secondary Schools in Nigeria.

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