EFFECTS OF MIND MAPPING STRATEGY ON ACHIEVEMENT OF SENIOR SECONDARY SCHOOL PHYSICS STUDENTS IN BOSSO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

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Abstract

The study investigated the effects of Mind Mapping Instructional Strategy on Achievement of Physics Students in Bosso local government area of Niger State. The research design employed was quasi-experimental design. Random sampling technique was used to select two Senior Secondary Schools for the study. Intact classes with a sample size of 145 (95 male and 50 female) SS II Physics Students was used. The research instrument was used to collect data from students was the thirty items multiple-choice Physics Achievement Test (PAT). The instrument was validated by experts. The reliability coefficients of PAT was 0.87 using Kuder Richardson (KR-21). Two research questions were raised and two null hypotheses formulated for the study. Analysis of Covariance was employed in analysing the data. The results showed that:(i) students exposed to mind mapping instructional strategy performed better than their counterparts that used conventional method; (ii) there was no significant difference in the mean achievement scores of male and female students taught Physics using mind mapping instructional stratey. In conclusion mind mapping strategy affects the students achievement positively. Therefore, it was recommended, among others, that mind.mapping strategy should be used in teaching physics at senior secondary schools.

Background of the Study

The place of physics in science Education, applied sciences, Engineering and Technology makes it highly important and imperative for science students' to take the subject seriously. Physics is the center point or focus to all science subjects owning to its contribution to the development of science and technology that has improved the quality of life and human activities. Alukwo, Okereke and Ezekannagba (2000) defined physics as the: mother of all science that deals with the composition and changes of matter. To be able to appreciate, control and effectively benefit and utilize our natural resources. It is important and imperative to acquire basic scientific knowledge a basic tool for all forms of industrial and technological advancement of any nation.(American physical society 2014).

Nigeria and many nations of the world have recognized the importance of science and technology especially physics in its developmental endeavors (Abubakar, 2014). This is because physics is the basic indexes in understanding the difficulties of modernize technologies (Aina, 2014). But students" academic achievement in physics

WAEC and NECO standardize examination has consistently been on a decline for over ten (10) years. For example in WASSCE chief examiners report for May/June result 2009, reported that the candidates population of 465,498 in physics recorded a standard deviation of 9.0 and an average score of 26 as against and a standard deviation of 9.43 and an average score of 20 in May/June 2010 WASSCE. This makes students' at secondary school level demonstrate negative attitude towards physics as the toughest of the three (3) conceptual sciences (Omosewo, 1999; Opondo, 2014). An indication reflected by the student academic achievement in physics WAEC and NECO Standardize examination for many years.

The Academic achievement of secondary school students' in science standardized examinations organized by the West African Examination Council (WAEC) and the National Examination Council (NECO) has been discouraging for the past 15years. The outcome or result obtained has consistently been on a decline. It has attracted the increased attention of parents, guardians, the public and the Government. Kanno (2000) and Ajagun (2001) cited in their research work that the performance of students' in science subjects especially physics has not been encouraging. Physics is an intellectually demanding and challenging subject. Physics required great or adequate mathematical skills for good understanding, it also requires strong practical foundation and knowledge in order to achieve success "merit or credit" in a standardize examination like WAEC and NECO.

Researchers have described the relative effectiveness of different teaching methods in helping students' understand physics concepts, such as in mechanics, electricity, radioactivity, waves, optics and light. Researchersencourage removing the complexities and difficulties of understanding physics concepts among students' through the identification and development of teaching strategies which will enhance physics students' academic achievement in physics .

In an attempt to find solution to the students poor performance, several approaches and methods of teaching science (physics) were postulated by various researchers, including; Concept Mapping (Ezenwa 2005,O'Donnell*et al.*, 2002) and Mind Mapping (Buzan and Buzan 1993).

Buzan who is the originator of Mind Maps excelled in his career by translating his personal study to the mind map, into a universally functional memory aid. Mind mapping is a visual form of note taking that offers an overview of the topic, and its complex information, allowing students to comprehend, create new ideas and build connections through the use of colours, images and words. He encourages the personalization of mind maps as a way for students to make cognitive links with the content presented in school. In order to do this, students must interact constructively with the information as they add key words, sketches, symbols, and other details to aid them in making connections between their prior knowledge and the content being studied.

Buzan and Buzan (1996) defines mind map as "an expression of radiant thinking and therefore a function of the human mind. It is a powerful graphic technique which provides a universal key to unlocking the potential of the brain". The mind map has four essential characteristics: The subject attention is crystallized in a central image; the main themes of the subject radiate from the central image as branches; branches

comprise a key image or key word printed on an associated line and topics of less importance are also presented as branches attached to higher level branches. The branches form a connected nodal structure.The use of mind mapping can be assisted with the adoption of colors, images, codes, and multi-dimensional approaches to help human memory, so that one could concentrate the mind on the central part, which is the crucial subjects (Cheng, 2008). Mind mapping is similar to concept mapping, which has recently become a popular technique used in adult education as well as other fields including psychology, medicine, among others (Hill, 2006). Therefore, both concept maps and mind maps are identical in their meta-cognitive mechanisms. These two learning strategies differ only in their structure and organization used to create the actual maps

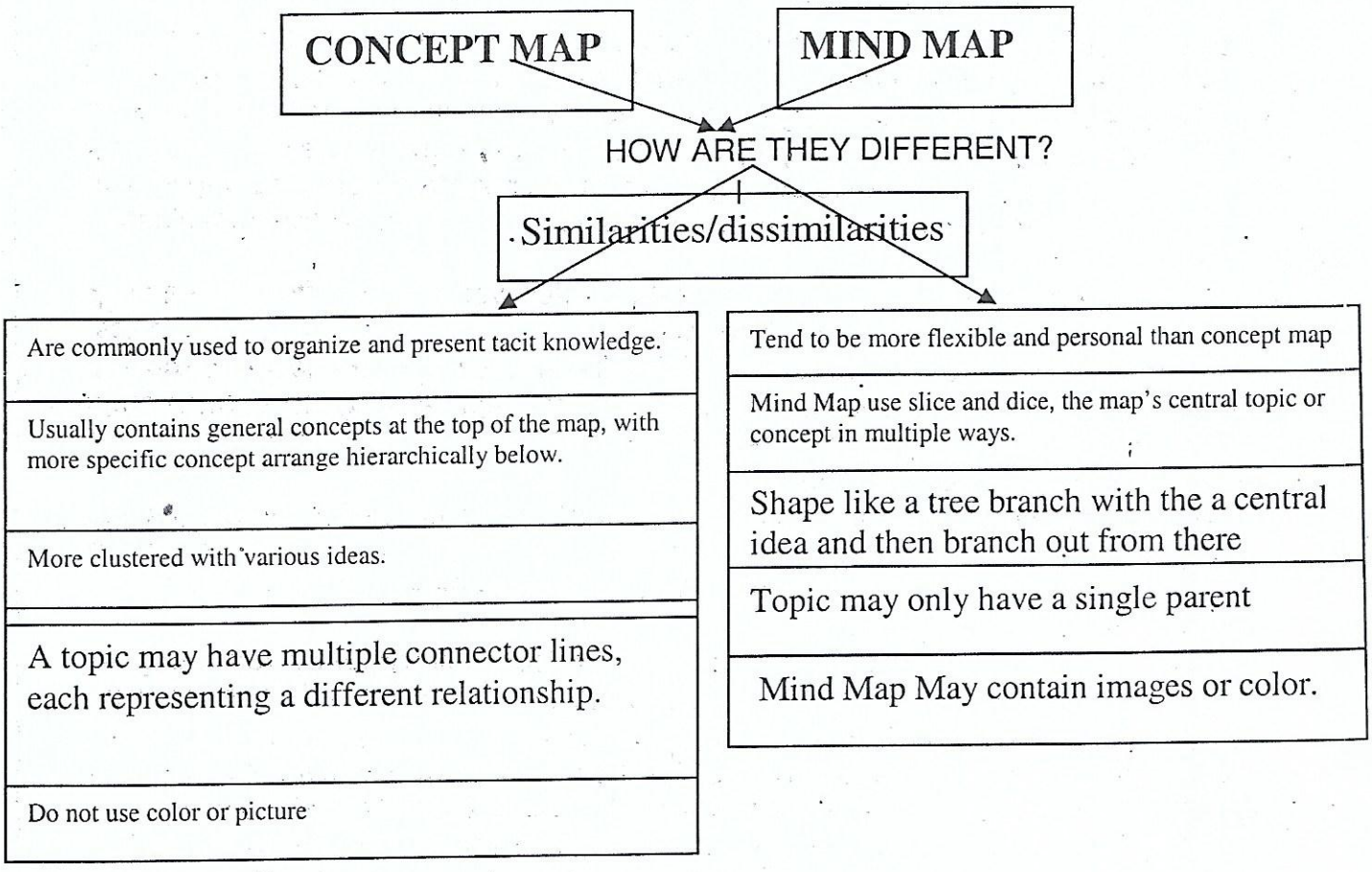

Figure 1.1 Comparison between concept map and mind map

A mind map is a graphic organizer in which the major categories radiate from a central image and smaller categories are portrayed as branches of larger branches (Budd, 2004). It can be used to generate ideas, take notes, develop concepts and ideas, and improve memory (Buzan, 2000). It is a powerful tool that teachers can use to enhance learning and create a foundation for learning. It is helpful for visual learners as

they are illustrative tools that assist with managing thought, directing learning, and making connections (Stephens &Hermus, 2007). It has been shown to be a great way to introduce an overall topic, increase students' involvement, and get thoughts down quickly. Mind mapping is a skill that cuts across ability levels and encompasses all subject matters (Goldberg, 2004). Mind mapping has considerable utility for tracking change in the course of learning, and has the capacity to distinguish between changes that are meaningful, and those that are not. Deep, surface and non- learning are tangible measures of learning that can be observed directly. (Hay, 2007). However , gender has been an issue with an inconclusive clue in the different strategies used by different researchers to improve learning performance.

Over 40 years of science, research has produced different theories of why gender differences in the performance and strategy occur. While early research concluded that women were afraid of success and attribution theory which explained that girls did not attribute their success to ability, but to effort and hard work (Meece*et al* 2006). Meece*et al* (2006) explained that gender differences in competency begin at an early age. Self-efficacy research also has shown that males are more efficacious than females in science, even when females perform better (Pajares, 2002).

Empirical studies showed that when a constructivist approach is adopted, mind mapping and concept mapping proved to be effective tools for facilitating learning (Erdogan, 2008; Akinoglu and Yasar, 2007; Riley and Ahlberg, 2004 &Buzan and Buzan, 1996). Mind Maps are used to visualize, conceive and classify thoughts in educational fields. In making mind mapping the use of colours, pictures, symbols make female to pay more attention and interact than male which could result in difference in achievement. Therefore this study will investigate the effects of Mind Mapping Strategy on Achievement of Secondary School Physics Students in Bosso Local Government Area of Niger State, Nigeria.

Statement of the Problem

Physics is one of the science subjects taught using different methods and many Physics teachers employed several methods in teaching to achieve meaningful learning and understanding by the students. For instance, Ifeakor (2006) emphasised the use of commercially produced computer assisted instructional package to teach Physics.Ates & Eryilmaz (2011) used concept mapping and analogy to teach physics. The poor physics performance of students in West African Examination Council is attributed to among other factors, method of teaching and motivation level of the learners. (WAEC, 2009).

From the analysis of the WAEC Results of 2008-2013, it was seen that candidates' results in Physics was generally poor. It revealed that the percentage of students that passed Physics at credit level and above (A1 - C6) was consistently less than 50% for the past five (5) years (2008-2013) in Nigeria. It was only in 2010 that 50% of students that sat for WAEC passed at credit level and above. In 2011 to 2013 the students scored below 50% .

Although researchers have identified several reasonsfor the poor performance in physics to include: inability of candidates to comprehend specific areas or topics in physics as a result of the general misconception that physics as a subject is abstract

and difficult to comprehend. Another reason is non-exposure of students to physics practical (WAEC, 2008& 20013). Several other physics teachers used diffirerent methods like Concept Mapping (Ezenwa, 2005; O'Donnell*et al*, 2002), Advance Organizers (Ojiaku, 2003; Tsaku, 2004 and Rufai, 2009), Vee Mapping (Osagbemi, 2004), Vee Maps Versus Standard Laboratory Reports (Thoron and Meyers, 2010), yet the performance of Nigerian students in the science subject did not improve as expected. As such, this paper intends to determine the effects of mind mapping strategy on achievement, of secondary school physics students in Bosso local government area of Niger State, Nigeria. Since mind mapping outlines the complex information that can lead to creativity, organisations, productivity and memory oreinted learning (Murlay, 2007).

Aim and Objectives of the Study

The aim of the study is to determine effects of mind mapping instructional strategy on academic achievement of Physics Students in BossoLocal Government AreaSecondary Schools. Specifically, the objectives of this study include:

i. To determine the effects of Mind Mapping Instructional Strategy on the achievement of PhysicsStudents inBosso Local Government Area Secondary Schools.
ii. To determines the Influence of gender on the achievement of students taught Physics with Mind Mapping Instructional Strategy (MMIS).

Research Questions

The following research questions were used as a guide for this study:

1 What isthe mean achievement scores of students taught physics with MMIS and those taught with Conventional Method?
2 What isthe mean achievement scores of male and female students taught physics with MMIS?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of students taught Physics with MMIS and Conventional Method.
2. There is no significant difference inthe mean achievement scores of male and female students taught Physics with MMIS.

Methodology

The study adopted a quasi-experimental design which involves the use of non-randomization as normally existing classes were assigned as treatment as well as non-treatment classes. In this paper, one independent variable (one treatment) was used. Dependent variable is the achievement scores. Gender was the moderating variables (male and female).The total experimental subjects utilized as population of the study were learners in SS II that are taught physics in Bosso Local Government Area

Secondary Schools. It consists of one thousand nine hundred and sixty-eight (1,968), 1,120 male and 866 female students for 2015/ 2016 session.Purposive sampling technique was employed to choose two schools because they are equivalent in terms of physics laboratories, infrastructural facilities and their physics teachers have the same teaching qualification. In addition, all the schools are Niger State Government owned co-educational schools. Two co-educational schools were selected for this study. The two schools were randomly assigned into experimental and control group.

Male students were ninety-five (95) while female students were fifty (50) in the two groups. The two Secondary Schools randomly (by balloting) assigned to experimental group are Bosso Secondary School (BSS) with seventy-five (75) students, (forty-five (45) male and thirty (30) female) and Government Day Secondary School (GDSS) Makunkele with seventy students (70) (fifty-three (53) male and seventeen (17) female) while the two Secondary Schools assigned to control group are Day Secondary School (DSS) Makunkele and experimental group Bosso Secondary School (BSS) . In each school there are two science classes, the researcher write 'yes' and 'no' on small paper rapped it and two students oneeach from the stream of the class was asked to picked one paper which was rapped. The student that picked yes, the class was used for the study. This was done in the two schools that were selected for the study. In each school the intact class was used and the sample population of the study was 145 students, 75 students were exposed to teaching with mind mapping instructional strategy (Experimental group) while 70 students were exposed to conventional method which was the control group.

Computer Assisted Physics Instruction Package of Mind Mapping Instructional Strategy (MMIS)was used to present lessons to the experimental group supported by projector. The first unit is the introduction of mind mapping instructional strategy lesson used to introduce mind mapping strategy to the experimental group. The remaining four physics units contained lessons structured using mind mapping instructional strategy. The learners must have 100% mastery of each question item before proceeding.Physics achievement test (PAT) contains 30 alternative option items

The validation of the instrument (Mind.Mapping Instructional Strategy package) took place in two phases: (a) Experts validity by computer software; (b) content validity by physics teachers.

Experts' Validity : Two educational technology experts Were asked to check the appropriateness of the package with regards to its suitability for instruction as well as simplicity.

Content validity: Two secondary school teachers who are currently teaching physics were requested to validate the procedures for their learning which is contained in the treatment. Two of them helped to ensure that all the contents and learning items are derived from the subject's curriculum and suitable for SS II Physics Students.The PAT were selected past questions based on the topics treated in the research. The PAT was given to two senior lecturers in the science education and Physics departments, Federal University of Technology, Minna, two physics teachers from Bosso Secondary School

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(GSS) Minna and Governent Secondary School Makunkele. Fourty (40) questions were forwarded for validation. Thirty (30) questions were selected.The achievement test instrument was trial tested and the reliability coefficient was found to be 0.87 utilizing Kuder Richardson's formula 21 (KR-21). To analyze the data gathered, mean statistics was used to answer the research question while Analysis of Covariance (ANCOVA) was utilized to test the null hypotheses at 0.05 alpha levels.

Results and Discussion

This section shows the analysis of information collected from the Physics Achievement Test based on the research question and hypothesis using Mean and ANCOVA statistical tools. The results are displayed in the tabular forms according to the questions as well as hypothesis tested.

Research Question One

What is the mean achievement scores of students taught physics with MMIS and those taught with Conventional Method?

Table 1: Average Scores of Learners Taught Physicswith Mind Mapping Instructional Strategy (MMIS) and Traditional Approach.

Groups	N	Pre-test		Post-test		
		Mean	SD	Mean	SD	Gain Score
Experimental	75	57.82	11.67	84.14	4.62	11.12
Control	70	51.60	8.56	73.02	5.73	

From Table 1, the mean post-test figure of the treatment class was 84.14 and standard deviation was 4.62 that of the class not taught with MMIS are 73.02 with standard deviation of 5.73. This result indicated that the experimental group upon which the research instrument was used attained more than the other category that was tuaght using traditional approach with mean score of 11.12.

Research Question Two

What is the mean achievement scores of male and female students taught physics with MMIS?

Table 2: Average Figures and Square root of variance of Masculine and Feminine Students of Experimental Group.

		Posttest	
Gender	N	Mean	SD
Male	45	69.12	11.09
Female	30	68.67	10.71

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Table 2 Shows average cognitive performance figures of male as well as female learners of treatment group. Male students had average cognitive performance figure of 69.12 as well as standard deviation of 11.09, female learners had mean achievement score of 68.67 and standard deviation was 10.71.

Hypothesis One

There is no significant difference between the mean achievement scores of students taught Physics with MMIS and those taught with conventional method.

Table 3: ANCOVA of Posttest Figures of Students Taught Chemistry with MMIS and those tutored with Traditional Category

Source	Sum of Squares	df	Mean Square	F	P_{value}
Corrected Model	3919.627	2	1959.814	17.568	0.000
Intercept	168038.935	1	168038.935	1591.048	0.000
Covariate (pretest)	2360.668	1	2362.667	21.365	0.000
Main Effect (Treatment)	773.429	1	762.429	6.327*	0.009
Error	27337.338	143	105.550		
Total	1104025.000	145			
Corrected Total	31256.966	144			

*: Significant at 0.05 level

Table 3 shows the ANCOVA result of the comparison of Post-test scores of students in experimental and control groups using pretest as a covariate. The table shows a significant main effect $F(1,145) = 6.327$; $P < 0.05$. Based on this outcome, the null hypothesis is rejected.

Hypothesis Two

There is no significant difference in the mean achievement scores of male and female students taught Physics with MMIS.

Table 4: Analysis of Covariance of Posttest Scores of Achievement Scores of Maleand Female Students of Experimental Group

Source	Sum of Squares	Df	Mean Square	F	P_{value}
Corrected Model	63.536	2	31.768	0.235	0.791
Intercept	81870.343	1	81870.343	605.391	0.000
Covariate (pretest)	8.765	1	8.765	0.065	0.799
Main Effect (Gender)	63.478	1	63.478	0.359^{ns}	0.359
Error	16904.432	73	135.235		
Total	582750.000	75			
Corrected Total	16967.969	74			

ns: not significant at0.05 level

Table 4.shows that there was no significant main effect at F (1,127) = 0.359, P > 0.05. Thus, hypothesis two was accepted. The result showed that there was no relevant statistical difference between the average cognitive performance figures of male as well as female learnerstaughtphysics with MMIS as seen in Table 2.

Summary of the Findings

1. There was relevant statistical difference in the average cognitive performance figures of MMIS as well as traditional group learners.
2. There was no relevant statistical disparity between the average achievement figures of male and female learners of MMIS group.

Discussion of the Findings

This research work was conducted to determine the influence of mind mapping strategy on cognitive attainment, of secondary schools Physics students in Bosso.
Hypothesis one revealed that there was significance difference between the average cognitive performance figures of students in the MMIS as well as traditional category. This discovery is in agreement with the research outcome of Abi-El-Mona and Ad-El-Khalick (2008) who reported that learners tutored utilizing MMIS performed better than their counterpart tutored without MMIS in science subjects. The discovery is also in consonance with the discovery of El-Mona and Adb-El-Khalick (2008) who reported a significant difference between learners that utilized mind maps and learners who used summative assessments.

Students that use mind maps had greater academic achievement than those that did notuse mind maps. In addition, they further reported that the ability of students to personalize mind maps is more impactful than the use of set of recognized images alone. In other words, this learning task can be highly differentiating and this personalizing has a relevant influence on their academic attainment. Students customize the style of their mind maps as they distinguish between their use of icons and text consistent with their personal learning styles.
Hypothesis two revealed that there was no relevant statistical disparity between the mean achievement figures of masculine as well as feminine learners of the experimental group. This confirmed the findings of Abdolahi, Javadnia, Bayat, Ghorbani, Ghanbari,

and Ghodoosi (2011) who carried out a comparative study on mind mapping power point presentation and conventional power point. The researchers found out that mind mapping class performed more than the conventional class. Feminine learners also performed very high than their masculine counterparts.

This confirmed the findings of Arigbabu and Mji, (2004) who reported that sex disparity in arithmetic has majorly shown that male achieve higher than females. Although it was discovered than female learners perform more on subjects that require domestic tasks like food and nutrition, home management, home economics as well as fashion designing. The findings also disagree with the findings of, Abubakar and Uboh (2010), Abubakar and Ejimaji (2010); Abubakar and Ihiegbulem (2010),Abubakar and Eze (2010) who revealed that there is no significance disparity in Mathematics, Physics, as well as Integrated Science and most science students.

This findings is in line with that of Kolawole (2008) who reported that there was no much disparity in sex disparity in arithmetic results at the primary school levels but there exist much bigger differences at the advance level of school or higher classes because elderly male learners displayed much.more higher performance than female learners. The finding of this study disagrees with Oyedeji (1991) who reported that there is relevant effect of sex disparity on cognitive performance with male learners scoring higher than females. Sex differences persist even within the mathematics classroom.

The application of mind mapping strategy in the learning of chemistry was found to be effective because it helped the students to analyze concept easily and enhance performance. Learners in treatment group perform more than those in non-experimental class. There exist statistical disparities in the performance of both groups. All the learners benefitted which shows that mind mapping is gender friendly in achievement. All the groups of students taught using MMIS in this research work were effective in instructional activity.

Recommendations

As a result of the outcome of the study, the under listed suggestions emerged:

I. The use of mind mapping strategy in experimental group proved to have positive effect on the achievements of students, therefore teachers should be encouraged to use mind mapping strategy.

II. Seminars, workshops need to be periodically planned for instructors for efficient utilization of mind mapping software in the schools internet. This could be done by the ministry of education using the holiday period to train teachers in the use of software as teaching strategy.

III. Students should be encouraged to improve sharing knowledge and skills among themselves to help them retain more of what they have learnt.

IV. Researchers should replicate mind mapping strategy in teaching science subjects in the rural areas of Nigeria.

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