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Mapping As An Independent Learning Strategy For Students' Academic Performance

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ABSTRACT
This study was carried out in an attempt to investigate the effectiveness of mind mapping approach as a learning strategy in the learning outcomes of students. The study adopted a quasi-experimental nonequivalent pretest-posttest design, comprising of four intact classes (two experimental groups and two control groups). The sample for this study was senior secondary school one (SS1) students made up of 133 male and 101 female students. A physics Achievement Test (PAT) was used to generate data. Two research questions and two hypotheses were answered and z test statistics were used in data analysis. The result from the study showed that the experimental group performed better than the control group and there was no significant difference in the mean scores of the male and female students. This study concluded that the mind mapping approach improved students learning outcome and the teaching method is not gender-biased.
Keywords: Mind mapping, Independent Learning, Learning Outcome, Physics

INTRODUCTION

The sages are right when they opined that nothing remains the same forever. The society has experienced rapid advancement in science and technology as such; countries are now classified as being world powers, developed, developing and underdeveloped based majorly on their scientific and technological strength.

Today, we cannot live our life without technology revolving around it every second. Technology has become a yardstick for measuring the level of development a nation has attained. For any nation to achieve a reasonable level of development, its citizens must be empowered with adequate skills and knowledge of science and technology.

The national policy on Education (FRN 2004) stated the need to train students to be able to make use of their environment in order to enhance the scientific and technological needs of society. While science involves the study of the Universe in its entirety, technology is the application of the knowledge of science.

The importance of Physics as a science subject is as vital as the technological invention all around us today. A typical scenario to show the importance of Physics is the research on the Physics of semi-conductors which enabled the first transistors to be developed in 1947. This rather simple device is the key component in all our electronic systems and it is now considered one of the most important inventions in human history. It is also the law of optics that describes the way light behaves that has led the development of optical fiber networks which has gradually brought the world closer together. There are countless more examples of research in Physics leading to the development of important technologies.

Physics as a branch of natural science which deals with the interaction between energy and Matter and the laws governing them interplayed under precise measurements and accurate results have found application in every facet of human endeavor ranging from breathtaking inventions in the field of medicine, agriculture, transportation, entertainment to innovation in information and communication technologies.

The assertion by Frank (2015) that in Physics, you don't have to go around making trouble for yourself, but nature does it for you, shows clearly that physics is one of the most active among the physical sciences and its principles form the basis in information technology which has reduced the world to a global village,(Oluwatosin & Bello, 2015).

The study of physics in schools and Universities is undoubtedly relevant to society today, however, there is no denying that physics is a tedious subject to study but its importance to society is far-reaching. In recent times, available statistics have shown low student enrolment, poor teaching methods, and the limited number of professionally trained physics teachers and poor performance of students in the subject (Ogunniyi 2009; Bello 2012, and Owolabi & Oginni 2013) in (Oluwatosin & Bello, 2015).

According to the Nigerian Educational Research and Development Council (NERDC), studies have revealed that the academic performance of Nigerian students in ordinary level physics was generally and consistently poor over the years (Isola, 2010). Research shreds of evidence abound and statistics gathered have reviewed weakness in the performance of students in ordinary level Physics.

In order to address these issues, research in science education in Nigeria and other educational boards has made a concerted effort to seeking better ways of teaching to facilitate students' understanding, assimilation and maximize meaningful learning.

Meaningful learning may be seen as the concept that the learned knowledge is fully understood by an individual and that the individual knows how that specific fact relates to other stored facts. Meaningful learning as opposed to rote learning and refers to a learning method where the new knowledge to be acquired is related to previous knowledge (Ausubel 2000). Meaningful learning, therefore, allows the student the freedom to reconcile new knowledge to the existing one. Interest development is one of the goals of meaningful learning, as students who are interested generally learn more effectively (Heddy, Benjamin, Sinatra, Gale, Seli, Helena, Taasoob-Shirazi, Gita, Mukhopadhyay & Ananya 2016).

Independent learning refers to the method where learners have ownership and control of their learning, they learn by their own actions and direct, regulate and assess their own learning. The independent learner is able to set goals, make choices, and decisions about how to meet his learning needs, take responsibility for constructing and carrying out his own learning, monitor his progress toward achieving his learning goals, and self-assess the learning outcomes. The concept of independent learning is associated with, a part of other educational concepts and wider policy agendas, such as improving the educational experiences and outcomes for learners through student-centred learning approaches that personalize learning and enable the learner to take ownership of the learning process, (Meyer, Haywood, Sachdeva, & Faraday 2008).

When the concept of independent learning is brought to the fore in the learning of Physics, the learners have greater control over the pace of learning and can assess his/her set learning goals to determine meaningful learning.

Mind map which was popularized by Tony Buzan is the use of diagrams that visually map information using branching and radial maps traces back centuries. Mind mapping is a learning technique that was developed in the 1970s that allows users to generate documents or maps in a graphic form that allows the user(s) or readers to see clearly the interrelationships between ideas and facts. It has been shown to be a very powerful tool in the transfer of details and knowledge while emphasizing the interconnection of this information. This is the true power of mind mapping and it has been validated through the results of research findings.

Mind maps can be generated in two ways, the first being a manual technique where the maps are hand-drawn. With manual techniques, there is a learning curve that must be overcome to generate maps effectively. It takes some practice in defining locations and placement of topics and details. It has been noted that the use of colors and symbols can positively influence the information retention of the presented information. If the maps are to be shared, photocopying or scanning must be used which can

slow the transfer of the map to others. It also makes the maps a reference document, not a living document for changes.

Mind mapping has seen a growth in interest and uses based on the ability to create the maps in a digital format; this is the second way in which maps can be generated. The electronic software that is now available allows the maps to be created quickly and reliably. These maps offer the same value as manual maps with the added benefits of being easily exchanged or viewed during courses or meetings while also allowing for the inclusion of other artifacts such as documents, drawings, pictures, multi-media, and internet links. Teams can use one map as a common placeholder of information and use it to grow the map into further detail, solutions, or ideas. This makes it a natural tool for creativity and innovation. These features have strongly impacted the acceptance of mind mapping not only on an individual level but also as a worthwhile tool in businesses.

Mind mapping is a revolutionary approach to both teaching and learning. Using mind maps as an innovative thinking tool in education helps students to visualize and externalize concepts and understand the connections between different ideas. It is commonly used in presentations, critical thinking, brainstorming, decision making, and project management.

Mind maps are highly effective visual aids that enable students to group together different ideas and enable teachers to present ideas visually and assess their students' conceptual development and understanding. Studies have shown that the use of mind mapping improves results, enhances simulation learning and makes a significant contribution to a positive learning experience.

A mind map is a diagram used visually to organize information. A mind map is hierarchical and shows the relationship among pieces of the whole. It is often created around a single concept, draw as an image in the center of a blank page, to which associated representation of ideas such as images, words and parts of words are added.

Mind map just like other diagramming tools can be used to generate, visualize, structure, and classify ideas, and as an aid to studying and organizing information, solving problems, making decisions and writing. According to Owolabi & Oginni (2013), graphic organizers allow students to follow along with the lecture and build learners' understanding of each concept with the instructor. It also allows the instructor to informally assess students' knowledge as the lesson progresses.

Thomas (2007) defined a mind map as a powerful graphic technique that harnesses the full range of cortical skills such as word, image, number, logic, rhythm, color and spatial awareness in a single, powerful manner. It, therefore, gives the freedom to roam the infinite expanses of the brain.

Mind mapping helps students to understand and absorb information. Research shows that the use of mind maps increases critical thinking and memory skills, particularly for students who are visual learners. Mind maps capture each individual's thought process and make it easier for students to communicate and present their ideas.

The diagrammatic form of mind mapping is a useful tool for successful study skills and independent learning, as students can recall information more easily through creating mind maps and can show understanding of cause and effect.

There are significant benefits of mind mapping in education for teachers, too. Teachers use mind mapping as a creativity building tool, whereby they can encourage students to look at problems from a new angle and introduce discussion and debate about the relationships between ideas. One of the key benefits of mind mapping for teachers is that the visual nature of these thinking tools allows teachers to monitor and assess their students' understanding of the topics covered. By doing this, they can structure future lessons so that they can fill any identified gaps in learning and further develop students' knowledge and understanding.

Mind maps always begin with a core concept or idea which is often represented with an image or single word in the centre of a page. Once the core concept has been chosen and visualized, branches are then created that represent single words that connect to the main concept. From there, sub-branches can be created that further develop ideas and concepts from the main branches. All of the ideas and concepts are connected to the overall theme of the whole mind map; this allows the teacher

to engage students with the bigger picture as well as the finer details. Through the creation of a mind map, students can understand the interconnectivity between ideas.

Mind maps can be created in two key stages – brainstorming and mind mapping. The brainstorming stage is also known as the "free-thinking" stage where the idea is first visualized and written in the middle of the page. Ideas should flow freely and all input is valuable. In the second stage, students can begin to map the relationships between the ideas and crucially identify the type of relationship between the ideas. The type of relationship could because, effect, similarity or contrast. Causality, in particular, introduces the concept that one idea might cause or be caused by the other.

Cunningham (2005) conducted a user study in which 80% of the students thought mind mapping helped them understand concepts and ideas in science.

Mind mapping increases students, creativity, and productivity because it is an excellent tool to generate more ideas, identify the relationship among different data information, and effectively improves memory and retention. Mind mapping facilitates learning activities and thus can be used as a valuable instructional technique to refine, improve learning and engage students in reflective thinking.

Objective of the Study

This paper aims to investigate the extent to which mind mapping subsumed in independent learning can be used to improve the learning outcomes of secondary school students in Physics. Concerted efforts have been made to study the effects of mind mapping on students' achievements on other science subjects; however, little studies have been done on Physics which is the most active of the core science subjects.

The specific objectives of this study are thus to;

1. Determine the effect of mind mapping on students learning performance in Physics.
2. Examine the effect of gender differences on students' performance in Physics.

Research Questions

1. What are the mean performance scores of students taught physics using the mind mapping strategy and the students taught physics using the conventional method?
2. What is the mean achievement score of male and female students in Physics?

Research Hypotheses

For this study to establish and determine the stated objectives, research hypotheses that are testable and analyzable based on data collected therefore need to be formulated.

The following research hypotheses were formulated to guide the study.

Ho_1: There is no significant difference between the mean performance scores of secondary school students taught Physics using mind mapping strategy and the student taught physics with the conventional method.

Ho_2: There is no significant difference between the mean performance scores of male and female students in Physics.

Research Design

This study adopted a quasi-experimental nonequivalent pretest-posttest control group design to identify the effectiveness of mind mapping strategy on students learning performance in Physics. This research design is used because secondary schools exist in intact classes and the randomization of students into groups for the purpose of experiment will not simply be allowed to avoid class disintegration and the introduction of bias.

The design is schematically represented as follows;

Q1	X1	Q3	Experimental group
Q2	X2	Q4	Control group

Where Q1 and Q2 are the pretest scores of Experimental and control groups respectively, also Q3 and Q4 represent their post-test scores.

X1 = Mind mapping strategy (Experimental group)

X2 = Conventional teaching approach (Control group)

Population, Sample and Sampling Techniques

The population of this study consists of senior secondary school class 1 (SS1) students in Port Harcourt City Local Government of Rivers State. The sample consisted of 234 (133 males & 101 females) Physics

students. Purposive sampling technique was used to select two schools that are mixed and have at least two streams offering Physics. The two schools selected were randomly assigned into four intact groups out of which there were two experimental and two control groups. The experimental group comprised of 125 students (72 males and 53 females) while the control group had 109 (61 female and 48 males)

Research Instrument

The instrument used for data collection was a researcher-made achievement test titled; Physics Achievement Test (PAT) which consisted of Twenty (20) structured multiple choice objective questions. The PAT was used as a pretest to be sure of the equivalent ability of the students and it was as well used as a posttest after the treatment has been administered to determine the effect of the treatment on the students' academic performances. The instrument was given to two secondary school physics teachers and an expert in measurement and evaluation for validation.

The test-retest method was used to generate two sets of scores from students outside the sample of this study and the scores were correlated using the PPMC to determine its internal consistency. The reliability coefficient of the instrument was 0.76.

Procedure for Data Collection

The researcher carried out the data collection procedure in stages for three weeks. The researcher visited the selected school for permission in using the students and some of the school facilities. Afterward, the Physics Achievement Test (PAT) was administered as a pretest to both the experiment and control groups to ascertain their equivalence in ability. In the second stage, the experimental groups were taught using the mind mapping strategy, taking cognizance of the students' previous knowledge on the concept of **ELECTROSTATICS**. The students were actively engaged and were encouraged to interact in groups, while the control groups were also taught **ELECTROSTATICS** using the conventional method where there no proper teaching model and no interaction among students. One period of 40 minutes was allocated for each group three times a week. In the final stage, the PAT was rearranged and administered to the two groups as a post-test. The post-test was scored and used to generate quantitative data which was analyzed using Z-test. The significance level of 0.05 was used to test the null hypotheses.

RESULTS

The results of the analysis of the post-test scores in PAT for the experiment and control group were analyzed and the results are presented below.

Hypotheses:

There is no significant difference between the mean score of students taught Physics using mind mapping approach and the mean score of students taught physics with the conventional method.

Group	Mean	S.D	n	S.F	DF	Standard Error	Z-Cal	Z-Crit	Decision
Experimental	14.4	3.07	125	0.05	232	0.485	10.20	1.96	Ho_1 Rejected
Control	9.45	4.18	109						

The data presented in table 1 above shows that the Z-calculated value of 10.20 is greater than the Z-critical value of 1.96 at 0.05 level of significance with a 232 degree of freedom. The null hypothesis (Ho_1) was rejected. This means there is a significant difference between the mean score of students taught Physics using mind mapping strategy and the mean score of students taught physics with the conventional method.

Hypothesis 2: There is no significant difference between the mean achievement scores of male and female students in Physics.

Table 2

Group	Mean	S.D	n	S.F	DF	Standard error	Z-cal	Z-crit	Decision
Male	14.35	2.97	133	0.05	232	0.36	1.67	1.96	Ho_2 Accepted
Female	14.95	2.46	101						

The data in table 2 above shows that the Z-calculated value of 1.67 is less than the Z-critical value of 1.96 at 0.05 level of significance with the degree of freedom of 232. The null hypothesis (Ho2) was accepted. This means that there is no significant difference between the mean achievement score of secondary school male and mean score of female students in physics achievement.

DISCUSSION OF FINDING

The findings of the study revealed that there was no significant difference in the performance of Physics students before they were taught Physics using the mind mapping strategy and the conventional approach. This suggests that the two groups were quite homogenous at the start of the study. It implies that students used for the study have relatively equal background knowledge of Physics.

The finding is in agreement that teaching with independent strategies improves learner performance and metacognitive awareness of their own learning. It was also found that the teaching method is not gender bias and therefore significantly enhanced the achievement of both the male and female students. The result also showed that the students in the mind mapping approach group performed better than those in the control group. This is in agreement with Farrand, Hussan & Hennessy (2002) who opined that mind mapping approach improved the performance of medical students, and Rooda (1994) that mind mapping is an effective tool for improving the performance of the student in nursing. It has been argued that the conventional teaching method is content centered in which teachers remain more active, more cognitive and less effective (Singh, 2004).

RECOMMENDATIONS AND CONCLUSION

The study was able to show that the mind mapping strategy is more effective in improving the academic performance of students in Physics when compared with the conventional teaching method. This implies that the mind mapping strategy has the capacity to help students associate ideas, think creatively, and make connections that might not be achievable in the conventional note-taking approach.

Based on the results obtained from this study, the following recommendations are then put forward;

1. Teachers should adopt mind mapping strategies and other metacognition when delivering instructions to enable meaningful learning and better assimilation among students.
2. Teachers should structure their lessons to include a number of strategies that can captivate students to explore, experiment and develop their creative activities/skills, (Opara 2010)
3. Students, on the other hand, should be actively involved in the learning process and encouraged to adopt mind mapping as a note-taking strategy to maximize learning.
4. Educational policymakers and Government should organize regular workshops for teachers to be abreast of the latest and innovative teaching strategies suitable for 21st-century learners.

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