EFFECTS OF MIND-MAPPING INSTRUCTIONAL APPROACH ON SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS' ACHIEVEMENT IN EVOLUTION IN MINNA, NIGER STATE, NIGERIA.

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Abstract

This study investigated the effects of Mind Mapping Instructional Approach (MMIA) on senior secondary school biology students' academic achievement in evolution in Minna, Niger State, Nigeria. A pretest posttest control quasi experimental design was adopted for the study. Two research questions were answered and two research hypotheses were formulated and tested at 0.05 level of significance. Simple random sampling was used to select two secondary schools in Minna Metropolis which were randomly assigned to experimental and control group. A total of 105 senior secondary school II students consisting of 56 females and 49 males were used for the study. The biology achievement test in evolution (BATE) developed by the researcher was the instrument used for data collection. It was validated and tested for reliability using Crombach alpha. A reliability coefficient of 0.76 was obtained. Pretest was given to the two groups before the treatment to know their entry behavior. Posttest was given to the two groups after being taught evolution concepts for four consecutive periods to test for their academic achievement. The results shows that the group taught using MMIA (experimental group) performed better than students taught with the conventional lecture method which is the control group. On the gender related issue, there was no significant difference in the mean scores of male and female students taught using MMIA. Based on the findings, it was recommended that the use of MMIA should be encouraged in teaching and learning of biology and other subjects because of its positive effects on boosting students' academic achievement.

Introduction

Teachers as transmitters of knowledge have had to develop, modify, improve and refine their approach so as to effectively and efficiently deliver instruction. Technological advancement, environmental and social changes have increased the need for teachers to adopt new methods of delivering instruction as the traditional approach which is teacher centered has made students passive listeners in the learning process (Al-jarf, 2009). Active learning occurs when students are doing things and thinking about what they are doing and meaningful learning happens when students integrate new information into what they already know (Adodo, 2013). Through active learning students are engaged in series of activities such as reading, discussing and writing, which also increases students' motivation to learn. Students can receive immediate feedback from their instructors and are involved in higher order thinking (analysis, synthesis and evaluation).

Scientific researchers have identified various areas of the brain and extensively explored these areas, through their exploration, teachers have utilized the information gained to help students learning in the classroom (Trevino, 2005). The educational sector is faced with numerous challenges ranging from lack of infrastructures, lack of equipment, inadequate teaching materials and lack of maintenance. Achievements in biology over the years, just like other science subjects, have been poor. For example, the West African Examinations Council Annual Reports show that less than 50% of candidates passed biology at credit level and above

between 2010 and 2016 (Abdool, 2016). Shodeinde (2013) and Parikh (2016) posited a reason for these poor achievements. According to them the instructional strategies adopted by teachers do not make the learning of biology easy for students'. Similarly, Achor (2014) identified that the methods used by teachers of science education contribute to students' poor achievements in science subjects such as biology. Parikh (2016) posited that prevailing teaching practices do not actively involve the learners in the learning process and seem to deprive the learners of taking part in their learning, thus, affecting their performances.

In the midst of all these challenges, the teacher is expected to perform efficiently. Individual differences among students have led the teachers to explore various teaching methods to meet the diverse needs. Teachers are expected to perform optimally and exhibit quality teaching with all these tools and demands. Now the question is "how can a teacher deliver effective instruction?" The use of graphic organizers is of old history, trees, graphs and radial maps and other visual hierarchies have been in use for centuries, used in learning memory, brainstorming, visual thinking; problem solving etc. A graphic organizer is simply a graphical or spatial representation of text concepts. It is an instructional tool that can help students to organize, structure the information and concept to relate with other concepts (Syaza, 2010). Graphic organizers are visual displays teachers use to organize information in a manner that makes the information easier to understand. Ausubel (1969) an educational psychologist saw the primary responsibility of the educator as the presentation of learning materials in a meaningful form not as a list of facts (Hector, 2011). He indicated that educators must find procedures that allow the learner to tie new knowledge into their prior cognitive structure. He proposed visual mapping as a tool per excellence to promote meaningful learning.

There are various graphic organizers used for effective instructional delivery but for the purpose of this study, the researcher will be using mind mapping and its effect on students' achievement. The origin of mind mapping instructional approach is accredited to Tony Buzan who in 1970 was having difficulty in the world of education and this led him to explore his strengths and was able to come up with a method to improve his learning and he termed this method "Mind Mapping". Mind mapping is the graphical representation of text content, it has been proposed as a technique to brainstorm and summarize information as well as a study method (Hector, 2011). (Buzan & Buzan (2006) stated that a mind map is a powerful graphic organizer of ideas which provides a universal key to unlock the potential of the individual brain. Buzan emphasized that, typical note taking is linear while thinking involves an interlinked network. Furthermore, note taking emphasizes the verbal components (a left brain process) while ignoring imagery (a right brain process). He concluded that mind maps tap into the non-linear thinking process and potentiates learning by using both the left and right brain capacities. The mind mapping technique is aimed at activating both hemisphere of the brain. Mind maps are useful for helping young students with the process of building conceptual understanding of content and promoting achievement (Abi-el-Mona & Khalick, 2008). By using mind maps instead of traditional methods, students are able to visualize links between non-linear ideas which in turn provide for creativity and meaningful learning (Carlson & Daniel, 2011).

Achievements in biology over the years, just like other science subjects, have been poor. For example, the West African Examinations Council Annual Reports show that less than 50% of candidates passed biology at credit level and above between 2010 and 2016 (Abdool, 2016). Shodeinde & Adodo, (2013) posited a reason for these poor achievements. According to them the instructional strategies adopted by teachers do not make the learning of biology easy for students'. Similarly, Al-jarf, (2009) identified that the methods used by teachers of science education contribute to students' poor achievements in science subjects such as biology.

Achor, (2014) posited that prevailing teaching practices do not actively involve the learners in the learning process and seem to deprive the learners of taking part in their learning, thus, affecting their performances. Educators looking for new ways to make their teaching engaging, active and students centered can use mapping tools to achieve the teaching and learning goals. Teachers can visually engage students by making maps that compliments or take the place of auditory and written information (Al-jarf, 2009).

Statement of the Problem

The traditional approach to teaching which has been in use for centuries involves the transfer of information from the teacher who is more or less like a sage to students who are mere receptacles. These students who have become passive listeners are not actively involved in the teaching and learning process therefore interest in the lesson most times is lost. Teachers in their quest to deliver effective instruction have had to refine their skills and broaden their knowledge to meet students' needs; also teachers have had to adopt new teaching methods that will promote effective teaching and learning of biology concepts. However, how effective are these new teaching methods? What impact do they have on students' achievement? Do they aid better understanding in learning? This study was set to determine the effect of mind mapping instructional approach on biology students' achievement in evolution concepts in Minna Niger state.

Purpose of the Study

The purpose of this study is to explore empirically the effect of mind-mapping teaching approach on Senior Secondary School Biology Students' achievement in evolution concepts. Specifically, the objectives of the study were to:;

(i) Determine the effect of mind-mapping Instructional approach (MMIA) on the achievement of biology students in evolution among Senior Secondary School students in Minna Niger State.

(ii) Find out if there is gender difference among students exposed to MMIA in evolution concepts

Research Questions

The following research questions were raised to guide the study:.

(i) What is the difference in the mean achievement scores of biology students taught the concepts of evolution using MMIA and those taught without it?

(ii) What is the difference in the mean achievement scores of male and female students taught the concepts of evolution using MMIA.

Research Hypotheses

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

Ho_1: There is no significant difference in the achievement scores of students taught the concepts of evolution using MMIA and those taught with conventional teaching method.

Ho_2: There is no significant difference in the achievement scores of male and female students taught the concepts of evolution using MMIA.

Methodology

A quasi-experimental design was used for this study; pretest, posttest, Non-equivalent and non-randomized control group design was adopted. This means that intact classes of biology were used without randomization. Omole, (2015) stated that among other conditions, when subjects for a study are selected and randomization of such subjects is not possible, rather intact classes are used for the study. The study investigated the effect of independent variable,

that is, mind mapping strategy, on students' learning achievement which is the dependent variable. The study also considered gender as one of its variables. The population of the study comprised of all senior secondary school II students (SS2) in Minna, Niger State, with the total number of 5,037 as indicated in the 2016/2017 annual statistics of the state Ministry of Education. The sample size for the study consisted of 105 students from two co-educational (mixed) secondary schools. The schools were chosen because they are of similar characteristics in terms of location, student types, and presence of skilled and experienced teachers as well as teaching and learning resources. The schools sampled include Government Day Secondary School, Minna and Bosso Secondary School, Minna. The SS2 Class of Bosso Secondary school, Minna was used as the control school while Government Day Secondary School, Minna was used as the experimental school. The control school had a total of 54 students, (25 male & 29 female) while the experimental school had a total of 51 students (24 male & 27 female).

The biology achievement test instrument in evolution (BATE) was developed by the researcher for data collection. It was made up of sections A and B. Section A was concerned with the personal data of students while Section B contains the test items. The BATE was used for collection of pretest and posttest achievement scores. The BATE items was made up of 20 multiple choice questions with four options. The items in the test, covers all the units that were taught. It was used to administer pretest and posttest for both experimental and control groups. After administration of Pretest, the question papers were collected so as to prevent the students from using it as a revision guide before the posttest. Two lesson notes were prepared by the researcher for teaching Evolution concepts. One of the lesson note was written based on conventional teaching approach and it was used for teaching Evolution concept to the control group, while the other was written based on the Mind Mapping Instructional Approach (MMIA), and was used to teach Evolution concepts to the experimental group.

The instrument used for data collection was validated by the experts. The instrument was validated in terms of simplicity of instruction, wordings of items, adequacy and level of coverage of items in addressing the purpose of the study. Corrections and comments given by the experts were used in restructuring the items. The corrected items were then administered to the students. Reliability of the instrument was established through pilot test which was conducted in a school different from the sampled schools used for the research. Test retest method was used to ascertain the reliability of the instrument. Test was initially given as pre-test and then administered a week later as post-test, the results from pretest and posttest were compared to ascertain the reliability of the instrument. Scores from both tests were then correlated using the Crombach Alpha in estimating the reliability coefficient. Internal consistency of 0.76 was obtained after encoding the scores for the item in the SPSS (Statistical Package for Social Science) software. The result obtained indicated that the item is reliable for the research and can serve the purpose for which it was developed.

The BATE was administered by the researcher and trained research assistants as pre-test to both experimental and control group. Objective question papers containing 20 items were given to students to tick the correct answer. The papers were retrieved from the students after the pre-test and marked by the researcher to obtain students' scores on cognitive achievement before treatment was administered. This gave a clear picture of students' performance before the treatment. The researcher prepared lesson notes for the conventional teaching approach to be used in teaching the control group and also lesson notes based on the mind mapping approach to be used in teaching the experimental group. The researcher guided and explained to the trained research assistants on how to go about teaching the experimental group. After one week, the researcher and the trained research assistants administered a posttest to

measure achievement. The post-test items were the same items used in administering the pretest. The papers for the BATE were gotten back from the students after the posttest and marked by the researcher to obtain the students achievement scores after treatment. Data generated from the biology achievement test in evolution (BATE), were subjected to statistical analysis to find the descriptive statistics and t-test was used to find out if there is significant difference in the mean score of the experimental and control groups and also that of male and female students taught using MMIA. All statistical analysis to test the hypotheses was done using (SPSS: version 20).

Results

The instrument used for the data collection was Biology Achievement Test in Evolution (BATE) which was used to measure the students' achievement in the pretest and Posttest for both experimental and control groups. The data that were obtained in the course of the study were: achievement scores from pre-test for both the experimental and control groups achievement scores from post-test for both experimental and control groups

Table 1: t-test Analysis of the Pre-test Scores of Experimental and Control Groups

Group	N	$\bar{X}$	SD	Df	t_{cal}	P.value	Remarks
Experimental	51	6.922	2.629	103	1.506	0.135	Not Significant
Control	54	6.226	2.054				

Not significant at P>0.05

From the table above, the result showed that there is no significant difference in the mean score of experimental and control groups at pre-test. The mean score of the experimental students taught using MMIA (6.922) is not significantly different from the mean score of the control students taught without using MMIA (6.226).with the P value of 0.135 which is greater than 0.05, the result showed clearly that the two groups were equivalent in terms of their entry knowledge on the concepts of evolution in biology.

Research Qquestion 1

What is the difference in the mean achievement scores of biology students taught the concepts of evolution using MMIA and those taught without it?

Table 2: Mean and Standard Deviation of Post-test Scores of Experimental and Control Groups

Group	N	$\bar{X}$	SD	MD	Remark
Experimental	51	13.10	2.73	2.93	Significant
Control	54	10.17	2.02		

From the above table, the result showed that there is significant difference in the Mean scores of the experimental and control group in favour of the experimental group. The Mean score of the experimental group taught using MMIA was (13.10) while that of the control group was (10.17). The result shows that there is a significant difference in the mean scores of students taught using MMIA and those taught without it.

Research Qquestion 2

What is the difference in the mean achievement scores of male and female students taught the concepts of evolution using MMIA?

Table 3: Mean and Standard Deviation of Post-test Scores of Male and Female Students in Experimental Group

Group	N	$\bar{X}$	SD	MD	Remark
Male	24	13.33	2.58	0.44	Not Significant
Female	27	12.89	2.89		

From the table above, the result showed that there is no significant difference in Mean scores of male and female students. The Mean of male students (13.33) and standard deviation of (2.58) is not different from that of female students with Mean of (12.89) and standard deviation of (2.89). The result shows that gender as a factor has not affected the achievement of MMIA in Evolution concepts.

Hypothesis 1

Ho_{01}: There is no significant difference in the achievement scores of students taught the concepts of evolution using MMIA and those taught with conventional teaching method.

Table 4: t-test Analysis of the Post-test Mean scores of the Experimental and Control Groups

Group	N	Mean	SD	df	t_{cal}	p-value	Remarks
Experimental	51	13.10	2.73	103	6.239	0.00	Significant
Control	54	10.17	2.02				

Significant at $P<0.05$

The result showed that there is significant difference between the experimental students taught using MMIA was (13.10) while that of the control students taught without using MMIA was (10.17). The t-cal value of 6.239 was found to be significant at 0.05 level (t= 6.239, df= 103, P= 0.00). Hence, the null hypothesis was rejected. That there is no significant difference in the achievement scores of students taught the concepts of evolution using MMIA and those taught with conventional teaching method is thereby rejected.

Hypothesis 2

Ho_{02}: There is no significant difference in the achievement scores of male and female Students taught the concepts of evolution using MMIA.

Table 5: t-test Analysis of the Post-test Mean Scores of Male and Female Students in the Experimental Group

Group	N	Mean	SD	df	t_{cal}	p-value	Remarks
Male	24	13.33	2.582	49	0.577	0.567	Not Significant
Female	27	12.89	2.887				

Not significant at $P> 0.05$

The result present the t-test analysis for mean posttest scores of male and female students taught using MMIA. The test was conducted to determine if the mean difference of 13.33 for male and 12.89 for female was significant or not. The t-cal of 0.577 was however found not to be significant at 0.05 level (t=0.577, df=49, P=0.567). Therefore the null hypothesis that the

achievement scores of students taught the concepts of evolution using MMIA is not significantly affected by gender is accepted.

Discussion

The finding revealed thatresults of the analysis of data were discussed. The discussions were made under the following sub-headings: Effect of mind mapping instructional approach on students' achievement in ecological concepts and the effect of mind mapping instructional approach on achievement of male and f female students in evolutional concepts.

The results in table 2 show the post-test mean achievement scores of students taught with Mind Mapping Teaching Approach (Experimental Group) outperformed those is higher than the post-test mean achievement scores of students taught with conventional teaching method (Control Group). This is further confirmed by the result in table 4 which revealed that the achievement of experimental and control groups differ significantly. The result indicated that treatment using MMIA produced significant difference on students' achievement in evolutional concepts. This agrees with the study of Abi-El-Mona and Adb-El-Khalick (2008) who found that there was a significant difference between students who used mind maps and those who don't on summative assessments. With students that used mind maps showing greater academic achievement.

Several possible explanations exist for the significant performance of the mind-mapping group when compared with the control group on the test. One possible reason is the exposure of students to the mind-mapping format, textbooks and other sources while being in school. When students are reading or utilizing textbooks, they are frequently exposed to the mind-mapping format. Thus, students begin to extrapolate information based on this format, (Adodo, 2013). Students in the mind-mapping group were able to extract and logically classify ecological concepts in an organized manner (Parikh 2016). However, participants in the control group were not able to abstractly create a drawing to coincide with ecological concepts,

Ausubel (1969) stated that individuals must be cognitively ready, which is dependent on prior knowledge and cognitive maturity. Based on students' prior knowledge, the experimental group could use previous exposure to mind-mapping and extract information presented. Thus, the information became meaningful (Ausubel, 1969; Novak, 1981) and students were able to learn in the mind-mapping format. In contrast, the control group did not have previous knowledge of mind mapping and had difficulty in creating meaning for learning.

Finally, instructional delivery could have been an influential factor. Effective teachers plan and sequence their instruction to assist learning. In effective delivery, teachers may organize information in mind-mapping form so students can actively extract and synthesize information to organize notes (Abdool, 2016). Having well-designed lessons and supplemental materials assist students with mind-mapping. Thus, significant results occurred. Various factors may have influenced test scores. Students' prior knowledge of mind-mapping format allowed them to more easily utilize and organize information. Students' level of cognitive development and cognitive readiness may have influenced how well they were able to utilize instructional strategies. Finally, the sequencing and planning of instruction by the researcher in a mind-mapping format allowed students to extract and synthesis information in an organized manner. This planning may be partially responsible for the higher test scores and two-week delayed comprehensive posttest scores received by students in the mind-mapping group.

The finding also revealed that results in table 3 shows the posttest mean achievement of male and female biology students taught evolutional concepts using MMIA. The mean achievement

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The finding also revealed that results in table 3 shows the posttest mean achievement of male and female biology students taught evolutional concepts using MMIA. The mean achievement

scores of the male and female students exposed to male students taught with MMIA is slightly higher than that of the female students taught with the same MMIA. This is further confirmed by the result in table 5 which indicated that treatment using MMIA did performed equally betternot produced significant difference on gender. The males regarded this as game or play and continue to practice it over and over again. This result agrees with Shodeinde, (2013) and Trevino, (2005) who stated that mind mapping is gender friendly. Furthermore, the result is in line with Parikh, (2016) that revealed little gender differences in achievement of males and females in Mathematics and science subjects.

Conclusion

In view of the research discoveries, the following conclusions were made:
Integration of the MMIA would lead to better academic achievement on the part of the students; the MMIA is seen as fun leading to a boost in the students' achievement, because students are actively involved in the construction of mind maps and they are able to learn meaningfully.

Recommendations

Based on the findings of this study, the subsequent discussion, and their implications, the following recommendations are made:

(i) The use of mind mapping strategy should be adopted by teachers in order to promote meaningful learning of evolution concepts in Biology

(ii) Teacher training programs should incorporate the teaching of pre-service teachers in the use of mind mapping. This will enable them to impact the use of the strategy in their students after graduation.

(iii) Seminar, conferences and workshops should be organized by ministry of education and administrators of Secondary Schools for serving teachers in the Secondary Schools to improve their knowledge and skill on the use of mind mapping which have been found in this study to be very effective in promoting student achievements in Biology

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