Effects of Concept Mapping Strategy on Students’ Interest and Performance in Biology in Abaji Area Council – Abuja

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Abstract
The study investigated the effects of concept mapping strategy on students’ interest and performance in Biology in Abaji Area Council of Federal Capital Territory Abuja. Two research questions and two hypotheses guided the study. The non-randomized control group, pretest-posttest design was used for the study. The population was made up of 1733 students across nine senior secondary schools. A sample of 77 senior secondary two Biology students from two secondary schools was drawn using purposive sampling technique. The instruments used for the data collection were; Biology Interest Inventory Scale (BIIS) and Biology Performance Test (BPT) which gave reliability coefficients of 0.97 and 0.74 respectively. The data collected were analysed using mean, standard deviation and tables to answer the research questions. Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings revealed that, there was no significant difference between the mean performance scores of students taught Biology using concept mapping strategy and those taught using lecture method (P=0.347>0.05). Results however showed significant difference between the mean interest ratings of students taught Biology using concept mapping strategy and those taught using lecture method (P= 0.035< 0.05). Based on the findings, it was recommended among others that Biology teachers should adopt concept mapping strategy for teaching and learning Senior Secondary School Biology contents.

Keywords: Biology, Concept, Mapping, Interest, Performance, Lecture, Method

Introduction
The 21st century is characterized by more advancement in science and technology. For a nation to be ranked higher in development, the quality of the education of her citizens is considered. Education has been described as an instrument for economic, political and scientific developments of all nations (Jibrin & Zayum, 2012). Scientific literacy is very important for a person because the developmental level of a nation is determined by the quality of human resources that possess science and technology awareness (Genc, 2015). No country has attained any breakthrough in its economic development without the development of adequate base in science. It is well known world-wide that science and technology are central to the changing world because they help to improve the supply of man’s basic needs like food, clean water, shelter, energy, basic health care and education. (Barnabas, Loretta & Achor, 2018).
Changes in science curricula around the world emphasize higher students’ participation and performance using various teaching methods and innovations. With this, attempts have
been made to shift instructions from mere rote learning to making it more meaningful to the learner. Agogo, Ogbeba, Damkor-Ikpa and Agogo (2018) posits that learning is only meaningful if the incoming knowledge properly anchors the already existing one. According to this view, meaningful learning is not just tagged to the previously learnt concept alone but it is fitted into a hierarchical structure. Therefore, the responsibility of teachers in schools is not only to teach students the particular content of knowledge needed, but also to help them develop successful lifelong skills of acquiring knowledge.

Science comprises the basic disciplines such as Mathematics, Physics, Chemistry, Biology, Agricultural Science. Researchers have observed that there is an increasing yearly enrolment in Senior Secondary Certificate Examination (SSCE) in Biology but each year, candidates achieved poorly in examination (Nnorom & Okoye, 2016; Okoye & Igboabuchi, 2017). Science education embodies all educational processes aimed at providing unlimited opportunities for learners to understand and utilize necessary knowledge, skills and attitudes required to operate effectively in a scientific and technological society. It is in attainment of this goal of science education that the researcher hopes to produce the required large pool of experts in sciences, which could help to bring about the much needed socio-economic development of a nation. These experts can only be produced through a well-organized and efficient science education.

Biology is a branch of science that deals with life and evolution of organism and their structure, process and interactions with each other and their environment (Aloh & Attana, 2013). It occupies a unique position in the curriculum of our educational system. Biology as one of the major science subjects is of paramount importance to every nation including developing ones. Knowledge of Biology is a requirement for many fields of study that have an immense contribution to the technological growth of the nation. These include, but not limited to, Medicine, Laboratory sciences, Pharmacy, Nursing, Physiotherapy and Agriculture. Secondary school Biology curriculum in Nigeria is designed to continue students’ investigation into natural phenomena, to deepen students’ understanding and interest in biological science and to encourage students’ ability to apply scientific knowledge to everyday life, in matters of personal, community, health and agriculture (Federal Ministry of Education, FME, 2013). These objectives can never be attained without a teaching strategy that could increase students’ interest and enhanced good performance in Biology.

A number of factors have been identified as working against students’ attainment of the objectives of science instruction. The most common factor identified is the inappropriate and uninspiring teaching methods adopted by science teachers (Cheema & Mirza, 2013). Researchers such as Kabutu, Oloyede and Bandele (2015) and Samuel (2017) observe that poor instructional strategies employed in the teaching of science subjects (Biology inclusive) by teachers contributes to students under-performance. The traditional teaching method such as lecture method of teaching, which is mostly used by teachers, does not give students the opportunity for active participation in the teaching/learning process. Lecture method is a teacher-centered teaching method involving one-way communication (Jayeshkumar, 2013). It makes students learn by rote/memorization and is not effective in learning difficult concepts. This method does not promote in-depth thinking, creativity and collaborative problem-solving. Also, students lose interest easily during lectures and information tends to be forgotten quickly when students are passive. A shift was therefore advocated by Samba and Eriba (2012) and Sakiyo and Waziri (2015) to methods that could enable the learner construct his/her own understanding. The innovative strategies are considered as effective teaching strategies that could enhanced students’ interest and improve academic performance in Biology. Using strategy such as concept mapping to motivate students’ prior knowledge were considered equivalent to preparing for a learning experience. The use of this strategy could produce significant gains in learning potential by recognizing prior knowledge as the basis for familiarity with concepts. Concept mapping serves as a tool to help learners organize their cognitive frameworks into more powerful integrated patterns. In this way, it serves as a meta-knowledge and a meta-learning tool. The proponents (Novak and his research team in the 1970s) of the concept mapping strategy posits that meaningful learning ensues when a learner is aware of, and can control the cognitive processes associated with learning. Concept mapping would be
an excellent strategy to enable students to think about connections between science terms being learned, organize their thoughts, visualize relationships between key concepts in a systematic way and reflect on their understanding. If concept mapping strategy is used in instruction, and students are required to construct concept maps as they are learning, unsuccessful students could become successful in making sense out of science and any other discipline. Concept mapping stresses meaningful learning, and appears to be ideally suited to capture students’ interest and enhanced better performance in Biology. It serves as a kind of template or scaffold to help to organize knowledge and to structure it even though the structure must be built up piece by piece with small unit of interacting concept and propositional framework (Jenning, 2012; Otor, 2013).

Concept mapping helps meaningful learning in several other ways. For example, concept mapping provides students with opportunities to organize, summarize, analyze and evaluate many different ideas. It also promotes the development of critical thinking skills, which can then be used to enhance meaningful learning (Novak & Canas, 2013). Furthermore, because the concept mapping process externalizes the concepts in the students’ existing knowledge structure, it is possible to identify misconceptions, incongruities and weaknesses in that existing knowledge structure.

Academic performance is a measurable and observable behaviour of a student within a specific period (Yusuf, Onifade & Bellow, 2016). The academic performance of students determines the success or failure of any academic institution (Narad & Abdullah, 2016). It is considered to be the centre around which the whole educational system revolves (Rono, 2013).

Interest is considered to be the feeling of an individual towards a particular object or an activity. It is pre-determinant of one’s perception (Essien, Akpan & Obot, 2015). A child will develop interest in any object or activity that is found to be attractive or stimulating. Therefore, in a classroom situation, the learner will be attentive during a lesson only if the instruction is appealing to the learner (Eriba & Samuel, 2018). It is Only by arousing students’ interest in learning Biology that students’ enthusiasm for learning Biology can be enhanced.

This research study was aimed at helping students in Biology to develop their ideas of Biology concepts and how to interrelate them using concept mapping strategy. Therefore, this study intends to use concept mapping teaching strategy with a view to finding how it could enhance students’ academic interest and performance in Biology.

Biology has been accorded recognition as one of the important science subjects. Yet, the way and the manner Biology is being taught in schools leaves much to be desired. Over the years, it has been observed with dismay that students’ academic performance in school especially in external examination namely, West African Senior School Certificate Examination (WASSCE) and National Examinations Council (NECO SSCE) has been on the decline in Nigeria. The poor academic performance in schools has become a major problem in the nation’s educational system. The foregoing situation therefore calls for a search for alternative strategies of teaching that could guarantee effective learning by students. Concept mapping teaching strategy could be effective in enhancing students’ interest and academic performance in Biology. This is because the strategy makes students to remember information longer and use it more effectively. It is against this backdrop of the continuous declined in students’ interest and academic performance in Biology that this study therefore investigates the effects of concept mapping strategy on students’ interest and performance in Biology in Abaji Area Council of Federal Capital Territory (FCT) Abuja, Nigeria.

Materials and method

Research Questions

The following research questions guided this study:

1. What is the difference in the mean performance scores of students taught Biology using concept mapping strategy and lecture method?
2. What is the difference in mean interest ratings of students taught Biology using concept mapping strategy and lecture method?
Hypotheses
The following hypotheses were formulated and tested at 0.05 level of significance:

- **H₀₁**: There is no significant difference in the mean performance scores of students taught Biology using concept mapping strategy and those taught using lecture method.
- **H₀₂**: There is no significant difference in the mean interest ratings of students taught Biology using concept mapping strategy and those taught using lecture method.

Research Method
The study adopted quasi-experimental design, specifically the pre-test and post-test non-equivalent control group design. The researcher administered a pre-test before treatment and after the treatment, post-test was administered to the experimental group (concept mapping strategy). The population was 1,733 senior secondary II students in nine government owned senior secondary schools in Abaji Area Council of Federal Capital Territory Abuja in the 2020/2021 academic session. The sample was 77 students offering Biology in two intact classes obtained using purposive sampling.

Biology Interest Inventory Scale (BIIS) and Biology Performance Test (BPT) were used to collect the data. The BIIS consist of four point Likert type questionnaire which consists of 30 items with response mode as Strongly Agree (SA=4), Agree (A=3), Disagree (D=2) and Strongly Disagree (SD=1). The BPT consists of 30 multiple choice questions with four options lettered (A-D). it has one correct response and three distractors. Correct response carries one mark while incorrect response carries zero mark. The test items were adapted from questions developed by Educational Research Centre (ERC), Abuja for promotion examination for 2015-2019 academic session.

The BIIS and BPT were validated by three experts in science education and measurement and evaluation in the Department of Science and Mathematics Education, Benue State University Makurdi. The reliability index of BIIS scores after trial test using Cronbach alpha was 0.97 and the BPT scores using Kuder Richardson formula (K-R 20) was 0.74. Thus, instruments were considered reliable for data collection for the purpose of the study.

The study covered five weeks and at the commencement of the study, BIIS and BPT were administered as pre-test and teaching began after the pre-test. The lesson plans were prepared by the researcher. The lesson plans were identical in terms of content coverage, time and mode of evaluation. The only difference is the instructional activities where concept mapping deviated from lecture method. The topics were from senior secondary II Biology curriculum. During the post-test, BPT was reshuffled and re-administered. The mean and standard deviation were used to answer research questions while hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Results and Discussion
The following results were obtained and discussed after data collected were analyzed.

Research Question 1.
What is the difference in the mean performance test scores of students taught Biology using Concept Mapping Strategy and Lecture Method?
Table 1: Mean and Standard Deviation of Performance Test Scores of Students Taught Biology Using Concept Mapping Strategy and Lecture Method.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-test Mean</th>
<th>S.D</th>
<th>Post-test Mean</th>
<th>S.D</th>
<th>Mean Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Mapping</td>
<td>40</td>
<td>12.43</td>
<td>3.62</td>
<td>19.23</td>
<td>5.03</td>
<td>6.80</td>
</tr>
<tr>
<td>Lecture Method</td>
<td>37</td>
<td>11.84</td>
<td>3.50</td>
<td>18.03</td>
<td>3.68</td>
<td>6.19</td>
</tr>
<tr>
<td><strong>Mean Difference</strong></td>
<td></td>
<td><strong>0.59</strong></td>
<td></td>
<td><strong>1.20</strong></td>
<td></td>
<td><strong>0.61</strong></td>
</tr>
</tbody>
</table>

Table 1 indicates that the pre-test mean performance scores of students taught Biology using concept mapping strategy was 12.43 and standard deviation of 3.62. On the other hand, the pre-test mean performance scores of students taught Biology using lecture strategy was 11.84 with standard deviation of 3.50 and mean difference of 0.59. Table 1 also reveals that the post-test mean performance scores for students exposed to concept mapping strategy was 19.23 with standard deviation of 5.03, while the post-test mean performance score for those taught with lecture method was 18.03 with a standard deviation of 3.68, and mean difference of 1.20. The mean difference was 6.80 for concept mapping strategy and 6.19 for lecture strategy. The mean gain difference was 0.61 in favour of concept mapping strategy.

Research Question 2.

What is the difference in the mean interest rating of students taught Biology Using Concept Mapping Strategy and Lecture Method?

Table 2: Mean and Standard Deviation of Mean Interest Rating of Students Taught Biology Using Concept Mapping Strategy and Lecture method

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-Interest Mean</th>
<th>S.D</th>
<th>Post-Interest Mean</th>
<th>S.D</th>
<th>Mean Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept Mapping</td>
<td>40</td>
<td>2.40</td>
<td>0.49</td>
<td>3.53</td>
<td>0.59</td>
<td>1.13</td>
</tr>
<tr>
<td>Lecture Method</td>
<td>37</td>
<td>2.30</td>
<td>0.57</td>
<td>3.14</td>
<td>0.85</td>
<td>0.84</td>
</tr>
<tr>
<td><strong>Mean Difference</strong></td>
<td></td>
<td><strong>0.10</strong></td>
<td></td>
<td><strong>0.39</strong></td>
<td></td>
<td><strong>0.29</strong></td>
</tr>
</tbody>
</table>

Table 2 shows that pre-test mean interest rating of students taught Biology using concept mapping strategy was 2.40 with standard deviation of 0.49. On the contrary, pre-test mean interest rating of students taught Biology using lecture method was 2.30 with standard deviation of 0.57 and mean difference of 0.10. The table also reveals that the post-test mean interest rating of students taught Biology using concept mapping strategy was 3.53 with standard deviation of 0.59, while post-interest mean rating of students taught using lecture strategy was 3.14 with standard deviation of 0.85 and mean difference of 0.39. The mean gain was 1.13 for concept mapping strategy and 0.84 for lecture method. The mean interest difference between concept mapping and lecture method was 0.29 in favour of concept mapping strategy.
Hypotheses Testing

Hypothesis 1

There is no significant difference in the mean performance scores of students taught Biology using Concept Mapping Strategy and Lecture Method.

Table 3: ANCOVA Test of Mean Performance Scores of Students Taught Biology Using Concept Mapping Strategy and those Taught Using Lecture Method

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>768.732</td>
<td>2</td>
<td>384.366</td>
<td>38.920</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>375.175</td>
<td>1</td>
<td>375.175</td>
<td>37.990</td>
<td>.000</td>
</tr>
<tr>
<td>Pretest</td>
<td>741.147</td>
<td>1</td>
<td>741.147</td>
<td>75.048</td>
<td>.000</td>
</tr>
<tr>
<td>Method</td>
<td>8.829</td>
<td>1</td>
<td>8.829</td>
<td>.894</td>
<td>.347</td>
</tr>
<tr>
<td>Error</td>
<td>730.801</td>
<td>74</td>
<td>9.876</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28280.000</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1499.532</td>
<td>76</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .513 (Adjusted R Squared = .499)

Table 3 reveals that $F_{1,76} = 0.894$; $P=0.347 > 0.05$. Therefore, the null hypothesis was not rejected. This means that there was no significant difference in the mean performance scores of students taught Biology using concept mapping strategy and that taught using lecture method.

Hypothesis 2

There is no significant difference in the mean interest rating of students taught Biology using Concept Mapping Strategy and Lecture Method.

Table 4: ANCOVA of the Mean Interest Rating of Students Taught Biology Using Concept Mapping Strategy and those Taught Using Lecture Method

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>6.815</td>
<td>2</td>
<td>3.408</td>
<td>6.927</td>
<td>.002</td>
</tr>
<tr>
<td>Intercept</td>
<td>19.928</td>
<td>1</td>
<td>19.928</td>
<td>40.507</td>
<td>.000</td>
</tr>
<tr>
<td>Pre interest</td>
<td>3.894</td>
<td>1</td>
<td>3.894</td>
<td>7.915</td>
<td>.006</td>
</tr>
<tr>
<td>Strategy2</td>
<td>2.279</td>
<td>1</td>
<td>2.279</td>
<td>4.633</td>
<td>.035</td>
</tr>
<tr>
<td>Error</td>
<td>36.405</td>
<td>74</td>
<td>.492</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>901.000</td>
<td>77</td>
<td></td>
<td>.492</td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>43.221</td>
<td>76</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .158 (Adjusted R Squared = .135)

Table 4 shows that $F_{1,76} = 4.633$, $P=0.035 < 0.05$. Therefore, the null hypothesis was rejected. The means that there is a significant difference in the mean interest rating of students taught Biology using concept mapping strategy and those taught with lecture method. The implication is that concept mapping strategy is superior to lecture strategy in enhancing students’ interest in Biology.
From the analysis of the data for the study, Findings indicated that there was no significant difference in the mean performance scores of students taught Biology using concept mapping strategy and lecture method. This is contradictory to the reports of Udeani and Okafor (2012), Mina (2017) and Sor, Jamabo and Igwe (2018). Udeani and Okafor (2012) established that students taught using concept mapping strategy performed better than those taught with lecture method. The performance of the students could be as a result of the time frame of two weeks of teaching before administering of post-test when compared to the present research of four weeks of teaching before administering the post-test. Mina (2017) also found that students taught using concept mapping strategy performed better than those taught using lecture method. The students’ performance could be attributed to the researcher’s involvement in the direct teaching of the lesson and administering of the post-test while the present research engaged the services of research assistants whom are the subject teachers of the respective schools to reduce Hawthorne effect on students’ performance. Sor, Jamabo and Igwe (2018) also found that students taught using concept mapping strategy performed better than those taught using lecture method.

Findings further showed significant difference in the mean interest rating of students taught Biology using concept mapping strategy and those taught with lecture method. It was observed that students taught using concept mapping strategy showed more interest in Biology than those taught Biology using lecture method. This is in line with Oviane and Lukmon (2017) who established that concept mapping strategy enhanced students’ interest more than lecture method. The finding is also in line with Imoko (2018) who found that concept mapping strategy empowers the learners to take charge of the learning in a highly meaningful fashion. This finding is also in agreement with Osuafor and Okigbo (2013) who found that use of lecture method of teaching was not appropriate with respect to interest in the learning of science (Biology).

Conclusion
The results obtained in this study have shown that concept mapping strategy is capable of improving students’ interest in Biology more than the lecture method. Furthermore, it was found that concept mapping strategy enhanced students’ performance more than lecture method. Based on the findings of this study, the following recommendations were made:

1. Biology teachers should be encouraged to use concept mapping strategy to ensure effective teaching and learning of Biology to improve performance.
2. Ministry of Education should ensure that teachers are trained regularly on the use of innovative instructional strategy like concept mapping.
3. Lecture method should be used with other innovative teaching strategies like concept mapping to enhance students’ performance and interest in Biology.

References