



## Enhancing Science Students' Academic Achievement on Bush Burning in Secondary School Using Graphic Organizers in Ibiono Ibom, Nigeria

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### Abstract

Bush burning is a menace in the Nigerian environment and appropriate instructional materials are to be used for students to evoke needed outcomes of knowledge on the concept for survival of the environment. The study employed graphic organizers to elucidate its effects on Academic Achievement of Science Students on Bush Burning in Secondary Schools, Ibiono Ibom, Akwa Ibom State, Nigeria. The population of the study was one thousand, three hundred and fifty-four science students and the sample size was one hundred and fifty. Three research questions and three null hypotheses guided the study. Quasi-experimental design of non-randomized pretest-posttest was adopted. The tool for data collection was Science Achievement Test on Bush Burning. Mean, Standard Deviation, Analysis of Covariance were used for data analysis. Findings on achievement showed that students taught bush burning using Concept Mapping and Semantic Mapping graphic organizers achieved significantly better than those taught using T-Chart graphic organizer.

**Keywords:** Concept mapping graphic organizer, Semantic mapping graphic organizer, T-Chart Graphic Organizer, Bush Burning, Gender.

### Introduction

For any country to attain success in its economic development, there has to be development of adequate science and technology base. This is achievable if science is learnt with practice through observation and experimentation. This will develop learners thinking capacity and widen their interest and curiosity (Etiubon & Udoh, 2017). It is therefore, obvious that no science concept should be learned in abstraction, but practically by the use of innovative instructional materials such as graphic organizers. Several studies on the use of instructional materials have shown that instructional materials have significant effects on students' academic achievement of science subjects. Graphic organizers are visual and graphic illustrations of verbal statements that organize ideas and demonstrate relationships between different information and concepts (Cox, 2021). They are used for a variety of educational purposes, including sequencing events, comparing and contrasting, and developing concepts in detail. The goal of a graphic organizer is to break down big ideas into simpler terms that are easy to digest. Cox (2021) posited that students improve achievement and remember information better and can better recall it when it is represented and

learned both visually and verbally. There are many forms of graphic organizers; each best suited for organizing a particular type of information. But for the purpose of this study, concept mapping, semantic mapping and T-chart graphic organizers will be considered.

Concept mapping graphic organizer is a graphical representation of knowledge that comprises concepts and relationships between them. It follows a hierarchical order where primary concepts are placed on top of the map, with the less inclusive ones placed below. It is used to organize information for easy understanding; simplify complex ideas; represent information visually; highlight key concepts in any topic and link them sequentially to deliver instruction in any subject or discipline for students' achievement (John, 2021). Semantic mapping graphic organizer uses graphical representation of words, ideas and concepts to link and arrange relationships round a central key concept or idea between different components to the main idea; that is how a part relates to the whole (John, 2021). This graphic organizer is a practical instructional material for students at all grade levels and an excellent tool for improving academic achievement among



students (Al-Otaibi, 2020). Classroom teachers use semantic mapping graphic organizer as instructional material to improve the teaching and learning process. It engages students actively in the learning process. The relationships among major concepts and their supporting details are presented visually on a semantic map. Schwab & Cable (2019) found that in the sciences, the visual structure of the map help students to connect major concepts with appropriate related details. They posited that semantic mapping graphic organizer be used in teaching the sciences. A T-Chart graphic organizer organizes a topic into two distinguished sets based on specific parameters such as differences, examples and characteristics (Morris, 2021). T-Charts are graphically used to organize thoughts about a decision by comparing and listing facts on a topic, explaining the strengths and weaknesses of a concept, listing linking characteristics of a topic to the main ideas of a salient detail for each idea (Chukwu & Dick, 2021). Bush burning is the concept under study and need to be explained in detail.

Students are to be deliberately taught bush burning to support greater understanding of their environment. Bush burning means to remove the cover of natural vegetation which guides the surface of the soil through fire use. Bush burning bring about hydrogen sulphide, ozone, hydrocarbon, nitrogen oxide, carbon monoxide, sulphur, and other oxidants as air pollutants. Other particulate nature pollutants obtained from bush burning are fume, dust, smoke and mist. (Otitaju et al., 2019). Uncontrolled and regular bush burning is a main issue in the forest zones of developing countries like Nigeria and has brought about deforestation with its resulting problems on biodiversity. Students need to learn how to manage and mitigate bush burning and its effects on man and environment.

Academic Achievement is the extent or ability, a student experiences to enhance learning. Dike (2021) describes academic achievement as the standing of a student scholastically at a given moment, stating individual abilities. Students' academic achievement are grades gotten from tests and examinations taken on subjects. Poor achievement in science may be linked to inadequacy of proper instructional materials (Attah, 2018). Using instructional materials in science teaching and learning enhances achievement of female and male students academically. Gender is mental, biological, physical, and behavioural characteristics between males and females (Manguwal, 2019). School science academic activities involve female and male students.

Male and female students are studied under gender. Gender of students may be a factor in determining students' academic achievement in science. Dania (2019) posited that male students achieved greater than the females in sciences. Arigbadu & Muji (2020) showed that female students perform as well as the males in sciences. Owolabi & Adaramah (2019) submitted that the interaction effects of treatment and gender, and main effect of gender was not significant. Nsofor (2016) also opined that female and male students could perform well in sciences if their learning conditions are the same.

### Statement of the Problem

Science subjects witness high enrolment in the final year of external examination like West African Senior School Certificate Examination and National Examination Council without a corresponding increase in students' academic achievement. Despite Federal and State governments inputs to encourage science teaching, students' failure rate in science subjects in the Senior School Certificate Examinations is still high. The reason for the poor academic achievement may be due to the teaching of science concepts particularly bush burning without the use of innovative instructional materials like graphic organizers to enhance learning and make the lesson interesting to students. It is against this backdrop that deliberate effort is constantly made to find out suitable instructional materials that will enhance effective teaching, learning and understanding of science concepts. Available literature show that limited research has been carried out in the area of using different graphic organizers particularly concept mapping, semantic mapping and T-chart as instructional materials to teach bush burning in secondary schools in Akwa Ibom State. Hence, this study poses a question as a problem; what is the effect of graphic organizers on students' academic achievement on bush burning in Ibiono Ibom secondary schools in Akwa Ibom State?

### Research Questions

1. What is the difference in mean achievement scores of science students taught Bush Burning using Concept Mapping, Semantic Mapping and T-Chart graphic organizers?
2. What is the mean achievement scores of male and female science students taught Bush Burning using Concept Mapping, Semantic Mapping and T-Chart graphic organizers?



3. What is the interaction effect of instructional materials, achievement and gender of science students on Bush Burning?

#### **Research Hypotheses**

1. There is no significant difference in the mean achievement scores of science students taught Bush Burning using Concept Mapping, Semantic Mapping and T-Chart graphic organizers.
2. There is no significant difference in the achievement mean scores of male and female science students taught Bush Burning using Concept Mapping, Semantic Mapping and T-Chart graphic organizers.
3. There is no significant difference in the interaction effect of instructional materials, achievement and gender of science students on Bush Burning.

#### **Research Design**

The study adopted quasi-experimental design. The study employed a non-randomized pretest-posttest experimental design. Quasi-experimental design is considered appropriate for the study because intact classes were used to avoid disruption of normal lessons. Three intact classes were used. Experimental group 1 was taught using concept mapping graphic organizer, experimental group 2 was taught using semantic mapping graphic organizer and experimental group 3 was taught using T-Chart graphic organizer.

#### **Population of the Study**

The study population was made up of all SS1 Biology students in nine co-educational public secondary schools in Ibiono Ibom with total enrolment of 1,354 students for 2022/2023 academic session (Source: Akwa Ibom State Secondary Education Board, 2023). This population was chosen because SS1 is the foundation class for senior secondary school Biology and classification of animals is in the SS1 scheme of work.

#### **Sample and Sampling Technique**

The sample size for the study was 150 SS1 Biology students chosen with the aid of simple random technique.

#### **Instrumentation**

The research instrument used for data collection was Science Achievement Test (SAT) on Bush Burning. The SAT was in two sections A and B. Section A contained students' personal data and section B contained a 25 test items.

#### **Validation of Instrument**

The validation of content was ascertained with test blue print. The face validity of the SAT was done after the items were written by a team of three experts, made up of experienced Biology teachers and specialists in test, evaluation and measurement. The validators did face validation of the questions on the document for clearness of words and adequacy in addressing the problems and objectives of the study. The comments and suggestions of the validators assisted the researcher to obtain the final version of the document.

#### **Reliability of Instrument**

Instrument reliability was done using 25 multiple-choice-test items and was given to 20 students in another school in Ibiono Ibom not selected for the study. The results passed through Kuder-Richardson's formula-21 and gave a high reliability index of 0.85.

#### **Research Procedure**

Science teachers were trained and used as research assistants. Three days was used to brief the research assistants on the modalities of the research study involving: giving of SAT, the procedures in teaching Bush Burning. The objective of the training was to enable the research assistants acquire competence for implementing the experimental conditions. During the treatment of the three experimental groups; after the administration of SAT as pretest to the students, the research assistants used the different graphic organizers to teach the students Bush Burning. The lesson lasted for three weeks. After the lesson, SAT was administered as posttest to the students. Answer scripts were collected, marked and scores used for analyzing data. Mean, standard deviation and ANCOVA were employed to analyze data collected.



**Results**

**Table 1: Mean, Standard Deviation and Mean Gain Scores of Students’ Pretest and Posttest Scores Taught Bush Burning Using Concept Mapping, Semantic Mapping and T-Chart Graphic Organizers**

| Graphic Organizers | N  | Pretest |      | Posttest |      | Mean Gain |
|--------------------|----|---------|------|----------|------|-----------|
|                    |    | Mean    | SD   | Mean     | SD   |           |
| Concept Mapping    | 49 | 3.70    | 1.98 | 21.12    | 2.03 | 17.42     |
| Semantic Mapping   | 54 | 3.56    | 1.34 | 21.98    | 2.59 | 18.42     |
| T-Chart            | 47 | 2.94    | 1.22 | 19.08    | 2.52 | 16.14     |

These results indicate that students taught bush burning using Semantic Mapping had the highest mean gain score, followed by those taught bush

burning using Concept Mapping while those taught using T-Chart had the lowest mean score.

**Table 2: Mean, Standard Deviation and Mean Gain Scores of Male and Female Students’ Pretest and Posttest Scores Taught Bush Burning Using Concept Mapping, Semantic Mapping and T-Chart Graphic Organizers**

| Graphic Organizers | Gender | N  | Pretest |      | Posttest |      | Mean Gain |
|--------------------|--------|----|---------|------|----------|------|-----------|
|                    |        |    | Mean    | SD   | Mean     | SD   |           |
| Concept Mapping    | Male   | 24 | 3.26    | 1.82 | 21.32    | 2.38 | 18.06     |
| Graphic Organizer  | Female | 25 | 3.97    | 2.06 | 21.00    | 1.81 | 17.03     |
| Semantic Mapping   | Male   | 28 | 3.52    | 1.30 | 21.83    | 3.11 | 18.31     |
| Graphic Organizer  | Female | 26 | 3.62    | 1.43 | 22.19    | 1.69 | 18.57     |
| T-Chart Graphic    | Male   | 23 | 3.21    | 1.38 | 18.42    | 2.69 | 15.21     |
| Organizer          | Female | 24 | 2.69    | 1.01 | 19.69    | 2.24 | 17.00     |

Data in Table 2 shows that the mean gain scores of male students taught bush burning using Concept Mapping, Semantic Mapping and T-Chart graphic organizers are 18.06, 18.31 and 15.21 respectively, while those of their female counterparts are 17.03, 18.57 and 17.00 respectively. These results indicate that male students’ mean gain scores taught bush burning using Concept Mapping graphic organizer is higher than those of their female counterparts; female students’ mean gain score taught bush burning using Semantic Mapping graphic organizer is greater than that of their male counterparts; and female students’ mean gain

score taught bush burning using T-Chart graphic organizer is higher than that of their male counterparts.

As shown in Table 2, interaction effects exist between graphic organizers (Concept Mapping and Semantic Mapping) and Gender Results also indicates that there exist no interaction effects between graphic organizers (Semantic Mapping and T-Chart) and Gender.

The hypotheses were tested using ANCOVA at .05 level of significance.



**Table 3: Analysis of Covariance (ANCOVA) of Students’ Posttest Scores Classified by Graphic Organizers with Pretest Scores as Covariates**

| Source of Variation |                   | Sum of Squares | Df  | Mean Square | F     | Sig. at P<.05 |
|---------------------|-------------------|----------------|-----|-------------|-------|---------------|
| Covariates          | Pretest           | 93.91          | 1   | 93.91       | 17.31 | .00           |
| Main Effects        | Graphic Organizer | 177.67         | 2   | 88.83       | 16.37 | .00           |
| Residual            |                   | 792.22         | 146 | 5.43        |       |               |
| Total               |                   | 1063.79        | 149 | 7.14        |       |               |

Table 3 shows that the calculated P-value, .00 of the main effects is less than the significance level. Thus, hypothesis one is rejected.

In order to determine the direction of significance, the Least Square Difference (LSD) posthoc pairwise comparison test was done and the results are summarized in Table 4.

**Table 4: LSD Posthoc Pairwise Comparison Test of Students’ Posttest Scores Classified by Graphic Organizers with Pretest Scores as Covariate**

| (I) Graphic Organizer              | (J) Posthoc Pairwise Comparison | Mean Difference (I-J) | Std. Error | Sign at P < .05 |
|------------------------------------|---------------------------------|-----------------------|------------|-----------------|
| Concept Mapping Graphic Organizer  | Semantic Mapping                | -0.91                 | .466       | .052            |
|                                    | T-Chart                         | 1.76*                 | .475       | .000            |
| Semantic Mapping Graphic Organizer | Concept Mapping                 | 0.91                  | .466       | .052            |
|                                    | T-Chart                         | 2.67*                 | .472       | .000            |
| T-Chart Graphic Organizer          | Concept Mapping                 | -1.76*                | .475       | .000            |
|                                    | Semantic Mapping                | -2.67*                | .472       | .000            |

Table 4 shows a mean difference (0.91) between students taught bush burning using Concept Mapping and Semantic Mapping graphic organizers; 1.76 between students taught bush burning using Concept Mapping and T-Chart graphic organizers and 2.67 between students taught bush burning using Semantic Mapping and T-Chart graphic organizers. The levels of significance displayed in Table 4 indicate that students taught bush burning using Concept Mapping

and Semantic Mapping graphic organizers achieved significantly better than those students taught bush burning using T-Chart graphic organizer. It can be inferred from the result that Semantic Mapping graphic organizer is the most facilitating, followed by Concept Mapping graphic organizer and T-Chart graphic organizer is the lowest. Therefore, those taught using semantic mapping graphic organizer achieved the best.



**Table 5: Analysis of Covariance (ANCOVA) of Male and Female students' Posttest Scores Taught Using the Different Types of Graphic Organizers with Pretest as Covariate**

| Source of Variation |                            | Sum of Squares | Df  | Mean Square | F     | Sig. at P<.05 |
|---------------------|----------------------------|----------------|-----|-------------|-------|---------------|
| Covariates          | Pretest                    | 93.91          | 1   | 93.91       | 17.68 | .00           |
| Main Effects        | Graphic Organizer          | 177.67         | 2   | 88.83       | 16.73 | .00           |
|                     | Gender                     | 6.56           | 1   | 6.56        | 1.24  | .27           |
| 2-Way Interactions  | Graphic Organizer * Gender | 26.18          | 2   | 13.09       | 2.47  | .09           |
| Residual            |                            | 759.48         | 143 | 5.31        |       |               |
| Total               |                            | 1063.79        | 149 | 7.14        |       |               |

Table 5 shows that P-value, .27 of the main effects of Gender is greater than the significance level. Thus, hypothesis two is retained.

As shown in Table 5, P-value, .09 of the interaction effect of Concept Mapping, Semantic Mapping, T-Chart graphic organizer and gender on Biology students' academic achievement is greater than the significance level. Thus, the null hypothesis is retained.

**Discussions of Findings**

Findings on difference in achievement mean scores of students taught bush burning with Concept Mapping, Semantic Mapping and T-Chart graphic organizers indicated a significant difference. Students taught bush burning using Concept Mapping and Semantic Mapping graphic organizers achieved significantly better than those taught with T-Chart graphic organizer. The findings may be linked to the prove that concept mapping and semantic mapping graphic organizers are great tools for summarizing that allow learners to brainstorm on information facts, ideas, themes, and questions that come to mind concerning identified concepts. The findings are in line with John (2021), that concept mapping graphic organizer is used to organize information for easy understanding; simplify complex ideas; represent information visually; highlight key concepts in any topic and link them sequentially to deliver instruction in any subject or discipline for students' achievement. The result of the study is also in line with Al-Otaibi (2020), that semantic

mapping graphic organizer increased students' academic achievement.

The findings on the mean difference of male and female students showed no significance. The findings affirm Arigbadu and Muji (2020), that there exist no differences in affective, psychomotor, cognitive students' achievements with regards to gender and that girls are advised to develop positive attitudes in science, which subsequently result in high academic achievement.

Findings on the interaction effects indicated no significant difference of instructional materials, achievement and gender of science students on bush burning. This implies that the mean achievement scores of male and female students were at the same level given the three graphic organizers. The findings are in support with Owolabi & Adaramah (2019) that the interaction effects of treatment and gender and main effect of gender was not significant.

**Conclusion**

On the bases of the study findings, it was confirmed that graphic organizers are instructional materials that enhances students' academic achievement of bush burning for both male and female students.

**Recommendations**

Based on the findings of the study, the following recommendations were made:

- i. Students should be encouraged to use graphic organizers to learn bush burning for effective understanding.



- ii. Teachers of science need to be advised to adopt graphic organizers as instructional materials for effective understanding of bush burning concepts.

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