

Concept Mapping, Field Trip Teaching Methods and Students' Performance in Basic Science and Technology in Etim Ekpo, Akwa Ibom State, Nigeria

Abaka, Nyakno Sunday

Utibe, Uduak James

Akpan, Anyanime Okon

Department of Science Education

Akwa Ibom State University, Ikot Akpaden, Mkpat Enin, Akwa Ibom State, Nigeria

nyaknoabaka87@gmail.com, uduakutibe@aksu.edu.ng.

anyanimeakpan@aksu.edu.ng. ORCID NO: 0000-0002-0654-4485

Utibe, Imaobong Uduak

Church of Jesus Christ Comprehensive Secondary School,

Atai Otoro, Abak, Akwa Ibom State. Email: imaobongutibe23@gmail.com

ABSTRACT

This study investigated the effect of Concept Mapping, Field-Trip teaching methods and students' performance in Basic Science and Technology in Etim Ekpo, Akwa Ibom State, Nigeria. Three research hypotheses were formulated to guide the study. The study adopted a quasi-experimental pretest-posttest comparison group design. The population comprised all the junior secondary two (JS2) Basic Science and Technology students in the 2025/2026 academic session in 10 public coeducational secondary schools in the area. The sample size was 190 JS2 Basic Science and Technology students (120 students in experimental group one and 70 in experimental group two). Using a simple random sampling technique, one intact class was sampled from two schools. Basic Science and Technology performance test in light energy (BSTPTLE) used for data collection with a reliability index of 0.82. Three validators from the Department of Science Education, Akwa Ibom State University, validated the instrument. The data collected were analysed using descriptive statistics to answer the research questions and ANCOVA to test the hypotheses at the 0.05 level of significance. The findings of the study revealed that; there was a significant difference between the performance mean scores of Basic science and technology students when taught light energy using concept mapping and field trip methods; there was a significant difference between the performance mean scores of male and female students in Basic Science and Technology in the concept of light energy and there was no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology. It was concluded that students' academic performance could be improved with a field trip rather than the concept map method. Based on these findings, it was recommended that the field trip method should be used in teaching light energy and other concepts in Basic Science and Technology.

Keywords: *Concept mapping, field-trip, light energy, performance, basic science and technology*

INTRODUCTION

Basic Science and Technology is a body of knowledge that is taught at both primary and junior secondary school levels of education in Nigeria. It is made compulsory for all students. The performance of students in Basic Science and Technology in public examinations has remained considerably poor (Akpan, 2024; NECO, 2026). According to Utibe and Onwioduokit (2019), the poor performance in Basic Science and Technology has been a matter of serious concern to all educators. Students' poor performance over the years might be attributed to teachers' use of inappropriate teaching methods, which makes students become passive and have less interaction with each other in Basic Science and Technology activities in schools. The traditional approach of teaching largely encourages students to memorise concepts, even in the area of practical, explanation of observed phenomena and comprehension. Inyang et al. (2023) asserted that much of the teaching in the classroom is superficial; in that facts, rules, laws and formulae are memorised, and information is not usually connected to a coherent framework that would allow students to make sense of it and to apply it in other new situations. The aims and objectives for teaching Basic Science and Technology are: to enable the learners develop interest in Science and Technology; acquire basic knowledge and skills in science and technology; apply scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the numerous career opportunities provided by science and technology; avoid drug abuse and related vices; be safety and security conscious and become prepared for further studies of science and technology (FRN, 2018; Umoetuk & Akpan, 2023).

The need for improved performance in Basic Science and Technology has driven teachers and researchers to seek appropriate teaching methods. These teaching methods are the ones that will allow students to control their learning process as well as develop the required interest in Basic Science and Technology. According to Utibe and Onwioduokit (2019), the increasing awareness of the importance of learner-centeredness in the teaching situation has generated a lot of attention in relation to understanding how learners learn and how to help them learn about concepts. These efforts in assisting learners to learn more effectively have led to the development of meta-cognitive methods (concept mapping and field-trip) to enhance meaningful learning. Eravwoke (2020) stated that one powerful way of organising knowledge is through the use of concept maps. Concept maps are classifications of a set of related ideas or events. Concept maps play a crucial role in guiding the production of knowledge and meaningful learning (Elechi, 2020). Meaningful learning is the formation of viable relationships among ideas, concepts and information (Lavoie, 2017). Concept mapping enhances meaningful learning by leading students away from rote learning and toward true understanding of concepts and their relationships (Anih & Egbo, 2022). They are useful tools for helping

students learn about the structure of knowledge and the process of knowledge production (Femi, 2022). These methods can represent the relationships among concepts in two-dimensional graphs. According to Imed (2022), concept mapping serves as a method to help learners organise their cognitive frameworks into more powerful integrated patterns. Concept mapping methods are those procedures that are used to measure the structure and organisation of an individual's knowledge. It is also a method that can be used to develop students' capacity to learn independently. A concept map is a graph structure containing nodes that are interlinked by labelled directed edges. The nodes, which are linked together into propositions, show how students connect or link concepts. The propositions are represented by arrows to connect individuals' concepts together; the directionality of the link is indicated by the arrow. The conceptualisation of the materials by the students is indicated by the directionality and the connecting proposition. The proposition thus illustrates the contextual relationship of the concepts to each other (Samba, 2022). Concept maps are based on the premise that concepts do not exist in isolation but depend upon others for meaning. Concept maps represent knowledge in a hierarchical form. The hierarchical structure is the means of linking concepts together (Ukpai et al., 2016). The proponents of the concept mapping method posit that meaningful learning occurs when a learner is aware of and can control the cognitive processes associated with learning. The process of concept mapping can reduce the need for rote memory and make learning more meaningful (Schmid, 2022). Thus, increases students interest, enhances practical skills irrespective of students ability level and gender.

A field trip is an outdoor teaching method that is organised for students to engage in learning what is not possible in normal classroom settings. The organisation may be based on a topic or a series of topics involving demonstrations and practical activities (Akpan et al., 2025). The reason for the outdoor learning is to allow the learners to have an opportunity to develop teamwork skills (Cooke-Nieves, 2022). A field trip is a vital teaching method for students because it allows the transfer of knowledge among students (Schofield, 2021). This occurs when students with experience in what is being learned share their knowledge with other students. These shared experiences serve to integrate the group members. Other studies, for example, Christian and Tiani (2022) reported that using fieldtrips as a teaching method enhances students' learning, and this in turn increases students' authentic knowledge. Many factors can hinder or enhance the effectiveness of these methods of instruction in schools if not guided. These factors are school location, class size and school types; these factors are considered and used as variables in this study.

Gender differences in learning science-related subjects are generated due to some genetic differences between females and males, and socio-cultural forces contribute to gender differences in basic science performance and ability, which include: the effects

of family, neighbourhood, peer, school influences, training and experience, and cultural practices (Akpan & Akpan, 2017). Ayodele (2020) states that female students tend to think that science-related subjects should be for males, and this thinking affects their performance in the subject. In the Basic Science class, most female students see themselves as inferior to the male students and may not be sufficiently motivated for the learning process. The feeling of inferiority and lack of motivation make the female students withdraw from the learning task. They tend to withdraw their interest, efforts and concentration from science-related subjects to other areas of study. This withdrawal hinders achievements in the subject by female students. Eriba and Demirer (2022) highlighted that males and females differ in sciences in their strategies, thought processes, self-concept and motivation. According to Ibok (2015), the males are good at problem solving using retrieval and have autonomous learning styles that helped them use complex strategies.

Chinaka et al. (2024) in a study examined the effect of concept mapping on Biology students' academic performance in secondary schools in Etche ethnic nationality of Rivers State. To achieve the purpose of the study, the researcher formulated four objectives of the study, four research questions, and four null hypotheses that guided the study. The research design used was quasi-experimental. The population of this study comprises a total of 11,113 Senior Secondary school students in Etche Ethnic Nationality of Rivers State. A sample size of 241 SS1 students was used for the study. The researcher applied purposive sampling techniques in determining the sample size. The instrument used for this study was the Biology Performance Test (BPT). The data gathered were analysed using statistical tools of mean and standard deviation to answer the research questions, while analysis of covariance (ANCOVA) was used to test the null hypotheses at a 0.05 level of significance. Based on the data analysis, the findings of the study revealed that the concept mapping strategy has a positive and significant effect on students' academic performance in biology and that male students relatively obtained higher mean scores than the female students when taught with the concept mapping strategy.

Akpan et al. (2025) in a study examined the effect of expository and field-trip teaching methods and students' achievement in Physics in secondary schools in Etim Ekpo and Ika LGAs, Akwa Ibom State, Nigeria. The study adopted a quasi-experimental pretest-posttest comparison group design. The area of the study was Etim Ekpo and Ika Local Government Areas of Akwa Ibom State. The population for the study comprised all 2691 senior secondary one (SS1) Physics students (1422 male and 1269 females) of the 2024/2025 academic session in the 12 public secondary schools in Etim Ekpo and Ika Local Government Areas of Akwa Ibom State. The sample size used for the study was 172 SS1 Physics students. One intact class was randomly sampled per school in four selected coeducational schools using a simple random sampling technique. The Physics

Achievement Test on Motion (PATM) was the instrument for data collection, with a reliability index of 0.87. The data collected were analysed using mean and standard deviation, and Analysis of Covariance (ANCOVA) to test the hypotheses at a 0.05 level of significance. The findings showed a significant difference between the mean achievement scores of Physics students when taught motion using the field trip method and those taught using the expository method. It is concluded that students' academic achievement could be improved when expository and field trip instructional methods are used. Hence, it is recommended that expository and field trip methods should be used in teaching motion in Physics.

The selection of what method to use should be guided by the instructional objectives, the content to be taught and the entry behaviour of the students. In addition to the good use of teaching methods, the teacher should vary the methods of teaching at all times. It is against this background that this study examines a comparative study of concept mapping and field-trip teaching methods of Basic Science and Technology and their effect on Students' Academic Performance in Secondary Schools in Etim Ekpo, Akwa Ibom State, Nigeria.

Statement of the Problem

From the review, it can be seen that teaching methods have a significant influence on students' performance in Basic Science and technology in secondary schools. Studies reviewed have shown that for Basic Science and Technology to be taught effectively, there should be other teaching methods that will improve students' performance in examinations. This new method of Basic Science and Technology teaching should be able to improve knowledge impartation and students' activities. This new way of teaching Basic science and technology is sometimes absent in the junior secondary school level in Nigerian classrooms, causing the researchers to now carry out this study to give a statistical position.

Purpose of the Study

The purpose of this study was to determine the effect of concept mapping, field-trip teaching methods and students' performance in Basic Science and Technology in Etim Ekpo, Akwa Ibom State. The study was designed to achieve the following specific objectives; to

1. Compare the performance mean scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods.
2. Compare the performance mean scores of male and female students in Basic Science and Technology in the concept of light energy.
3. Determine the interaction between teaching methods and gender on students' academic performance in Basic Science and Technology.

Research Hypotheses

To guide the researcher in the conduct of the study, the following null hypotheses were tested at 0.05 level of significance.

1. There is no significant difference between the performance mean scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods.
2. There is no significant difference between the performance mean scores of male and female students in Basic Science and Technology in the concept of light energy.
3. There is no significant interaction between teaching methods and gender on students' academic performance in Basic Science and Technology.

METHOD

This study adopted a quasi-experimental pretest-posttest comparison group design (Price *et al.*, 2024). This design was considered appropriate because it allowed the researcher to use the intact classes in the school without disrupting the teaching session in the school. The structure is as shown below:

E₁ (taught using concept mapping method): O₁ (pre-test) X (Treatment) O₂ (post-test)
E₂ (taught using field trip method): O₁ (pre-test) X (Treatment) O₂ (post-test)

This study was conducted in public coeducational secondary schools in Etim Ekpo, Akwa Ibom State, Nigeria. The reason for the choice of this area for the study is that the performances of students in Basic Science and Technology over the years are very poor. The population of this study comprised all the junior secondary two (JS2) Basic Science and Technology students in the 2025/2026 academic session. There are 10 public coeducational secondary schools with 1894 Junior Secondary Two (JS2) Basic Science and Technology students (Etim Ekpo LEC, 2026).

The study sample comprised 190 JS2 Basic Science and Technology students (120 students in experimental group one and 70 in experimental group two). Two public coeducational secondary schools were selected using a simple random sampling technique. The researchers developed an instrument tagged Basic Science and Technology performance test in light energy (BSTPTLE), used for data collection. The BSTPTLE have two sections, A and B. Section A elicited personal information such as gender of the respondents, while Section B comprise of 30 objective tests in Basic Science and Technology with four options lettered A – D, with only one correct option; the students were expected to tick only one option as an answer. The items were drawn to cover concepts in light energy and related sub-concepts. The instrument was used for measuring the students' pre-test and post-test performance in Basic Science and Technology.

Face validation was used for validating the instrument and the lesson packages. Three validators from the Department of Science Education, Akwa Ibom State University, validated the instrument. The test blueprint was used as a guide in the development of the test items to ensure content validation of the items used. To establish the reliability of the BSTPTLE, the instrument was administered to a trial testing group of 30 students in schools of comparable status in the area of study that was not used in the main study. The scores obtained were subjected to KR20 statistics since the instrument was dichotomously scored. The result obtained showed a reliability coefficient of 0.82. The instrument was deemed reliable and suitable for conducting the study because of the high reliability index. The researchers obtained relevant permission from the Director of Schools, Local Education Committee (LEC), and Etim Ekpo for the use of the two selected secondary schools in the area for the conduct of the study. The approval was conveyed to the Principals of the selected schools for proper arrangement for use of the Basic Science and Technology teachers, students and laboratory facilities in the school for the conduct of the study, having briefed them of the purpose and the benefit of the study to the students, school and the Ministry of Education. All the groups were taught the same concept on light energy, but with different teaching methods. The scores obtained from pretest and posttest were analysed using descriptive statistics to answer research questions, while the null hypotheses were tested using Analysis of Covariance (ANCOVA) with pretest as covariates. All hypotheses were tested at the 0.05 level of significance.

RESULTS AND DISCUSSION

Table 1: Summary of descriptive statistics of the mean Pretest and Posttest performance scores of the Students taught light energy using concept mapping and field-trip methods

Teaching Methods	N	Pretest		Posttest		Mean Difference
		\bar{x}	SD	\bar{x}	SD	
Concept map	120	4.44	3.29	16.92	4.71	12.48
Field-trip	70	5.50	2.67	23.20	2.46	17.70

Table 1 shows the pretest and posttest mean scores of students taught with concept mapping and field trip methods. Based on the result, students taught light energy using concept map method had a pretest performance mean score of $\bar{x} = 4.44$ (SD = 3.29) and a posttest mean score of $\bar{x} = 16.92$ (SD = 4.71). The mean difference score was 12.48, On the other hand, the field trip method had a pretest performance mean score of $\bar{x} = 5.50$ (SD = 2.67) and a posttest mean score of $\bar{x} = 23.20$ (SD = 2.46) with a mean difference score of 17.70. The differences existing between the performance mean scores

of Basic Science and Technology students' when taught light energy using concept map and field-trip methods are 5.22. This shows that the field-trip method was more potent in improving the performance mean scores of students in light energy.

Table 2: Summary of descriptive statistics of the mean Pretest and Posttest performance scores of male and female Students in light energy

Gender	N	Pretest		Posttest		Mean difference Score
		\bar{x}	SD	\bar{x}	SD	
Male	96	5.92	3.71	26.24	2.70	20.32
Female	94	3.20	3.46	17.28	2.93	14.08

Table 2 shows the mean pretest and posttest performance scores of male and female Students in light energy. The result shows that male students in Basic Science and Technology in the concept of light energy had a pretest mean score of $\bar{x} = 5.92$ (SD = 3.71) and a posttest performance mean score of $\bar{x} = 26.24$ (SD = 2.70). The mean difference score was 20.32. More so, female students in Basic Science and Technology on the concept of light energy had a pretest mean score of $\bar{x} = 3.20$ (SD = 3.46) and a posttest performance mean score of $\bar{x} = 17.28$ (SD = 2.93) with a mean difference score of 14.08. The difference existing between the performance mean scores of male and female students in Basic Science and Technology in the concept of light energy is 6.24. This shows that male students perform better than female students in Basic Science and Technology in the concept of light energy.

Table 3: Mean interaction between instructional materials and gender on students' academic performance in light energy

Teaching methods	Gender	N	Pretest		Posttest		Mean Gain	Mean Difference
			Mean (\bar{x})	SD	Mean (\bar{x})	SD		
Concept map	Male	54	5.96	0.95	25.86	0.85	19.90	6.64
	Female	42	3.50	1.27	16.76	1.56	13.26	
Field-trip	Male	36	5.88	1.09	26.62	1.62	20.74	4.98
	Female	34	2.94	1.25	18.53	1.66	15.59	

Table 3 reveals the pre-test mean and standard deviation scores ($\bar{x}=5.69$, SD=0.95) of the male students who were taught using concept map and posttest mean and standard deviation scores ($\bar{x}=25.86$, SD=0.85) of the same group with mean gain of 19.90; the pre-test mean and standard deviation scores ($\bar{x}=3.50$, SD=1.27) of the female students



who were taught using concept map and posttest mean and standard deviation scores (\bar{x} =16.76, SD=1.56) of the same group with mean gain of 13.26. Also, for students in the field-trip teaching method, the pre-test mean and standard deviation scores (\bar{x} =5.88, SD=1.09) of the male students and a posttest mean and standard deviation scores (\bar{x} =26.62, SD=1.62) of the same group with mean gain of 20.74; the pre-test mean and standard deviation scores (\bar{x} =2.94, SD=1.25) of the female students and posttest mean and standard deviation scores (\bar{x} =18.53, SD=1.66) of the same group with mean gain of 15.59. The standard deviation scores in all the groups reveal that students' performance in Basic science and technology did not differ widely based on their gender. This result was further explained and supported using the interaction graph in the Figure below, which shows that there was a significant interaction effect of teaching methods and gender on the performance mean scores of Basic Science and Technology students in light energy. This is evidenced in the graph because the interaction lines of treatment against gender do not intersect at a point, as shown below. Hence, there is no significant interaction between teaching methods and gender on students' academic performance in Basic Science and Technology.

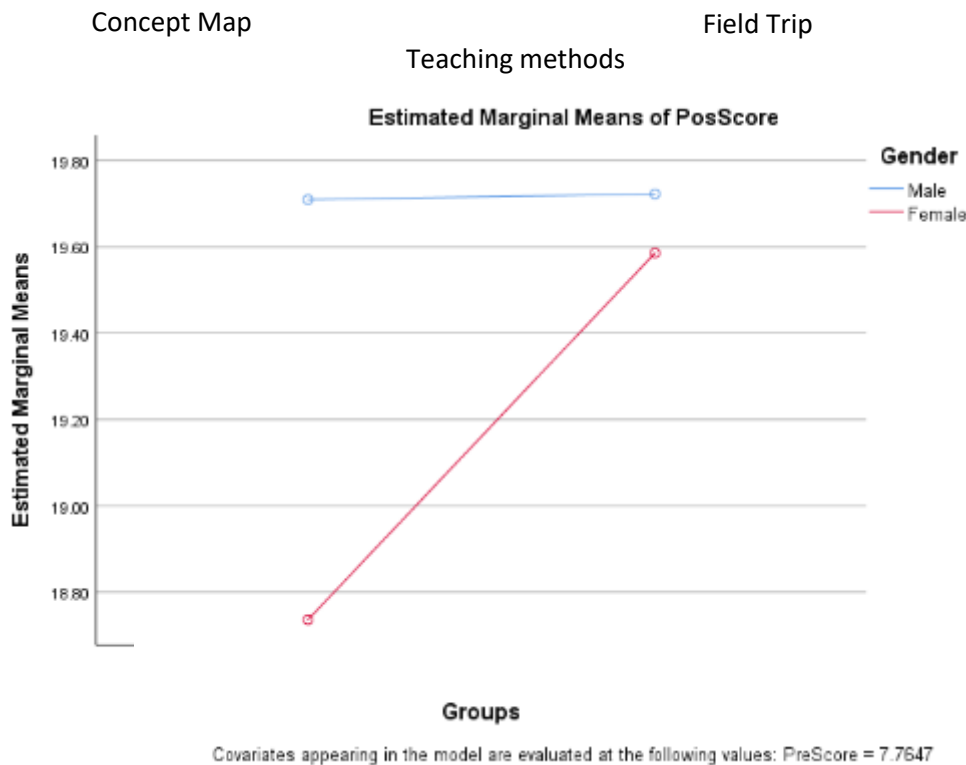


Table 4: Summary of Analysis of Covariance (ANCOVA) of the performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	24.42 ^a	4	3.052	1.38	0.22	0.16
Intercept	538.49	1	538.49	243.99	0.00	0.81
Pretest Score	0.28	1	0.28	0.13	0.02	0.00
Teaching methods	23.00	1	3.00	4.36	0.05	0.32
Gender	34.99	1	6.99	9.26	0.04	0.40
Teaching methods * Gender	2.82	1	2.82	1.28	0.26	0.47
Error	130.22	185	2.21			
Total	25817.00	190				
Corrected Total	154.63	189				

a. R Squared = 0.158 (Adjusted R Squared = 0.44)

b. Dependent Variable: Postest

Table 4 shows the significance of the difference in the mean performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods. With an F-ratio of 4.36 and a p-value of 0.05, which is not greater than the 0.05 level of significance, the null hypothesis, which states that there is no significant difference between the mean performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods, was found to be significant. Therefore, the null hypothesis that there is no significant difference between the performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods is rejected. Hence, there is a significant difference between the mean performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods. The effect size of 0.32 indicates that 32% change in students' performance in Basic Science and Technology can be attributed to the use of either concept mapping or the field-trip teaching method.

Table 4 also shows the significance of the difference in the mean performance scores of male and female students in Basic Science and Technology in the concept of light energy. With an F-ratio of 9.26 and a p-value of 0.04, which is less than the 0.05 level of significance, the null hypothesis, which states that there is no significant difference between the mean performance scores of male and female students in Basic Science and Technology in the concept of light energy, was found to be significant. Therefore, the null hypothesis that there is no significant difference between the mean

performance scores of male and female students in Basic Science and Technology in the concept of light energy is rejected. Hence, there is a significant difference between the mean performance scores of male and female students in Basic Science and Technology in the concept of light energy. The effect size of 0.40 indicates that 40% change in students' performance in Basic Science and Technology can be attributed to gender (male and female).

Table 4 shows the significance of the interaction between teaching methods and gender on students' academic performance in Basic science and technology. With an F-ratio of 1.28 and a p-value of 0.26, which is greater than the 0.05 level of significance, the null hypothesis, which states that there is no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology, was not found to be significant. Therefore, the null hypothesis that there is no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology is accepted. Hence, there is no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology. The effect size of 0.47 indicates that 47% change in students' academic performance in Basic Science and Technology can be attributed to the interaction between the teaching methods and gender.

Table 4 shows a significant difference between the performance mean scores of Basic science and technology students when taught light energy using concept mapping and field-trip methods. This implies that hypothesis one is rejected. The initial differences in performance mean scores among those exposed to concept map and field trip methods were found to be significant when subjected to hypothesis testing. The findings were in line with the work of Akpan *et al.* (2025), which examined the effect of expository and field-trip teaching methods and students' achievement in Physics in secondary schools in Etim Ekpo and Ika LGAs, Akwa Ibom State, Nigeria. Table 4 further shows a significant difference between the mean performance scores of male and female students in Basic Science and Technology in the concept of light energy. This implies that hypothesis two is rejected. The initial differences in the mean performance scores of male and female students in Basic Science and Technology were found to be significant when subjected to hypothesis testing. The findings were in line with the study conducted by Chinaka *et al.* (2024) to investigate the effect of concept mapping on Biology students' academic performance in secondary schools in Etche ethnic nationality of Rivers State. Table 4 also reveals no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology. Thus, the use of concept maps and field-trips in teaching the concept of light energy in Basic science and technology was not gender-biased, hence the result obtained. This result could be attributed to both groups building more confidence while learning in the different teaching methods. This, of course provides them with novel opportunities to

engage in the learning process. The findings agree with Chinaka *et al.* (2024), whose study investigated the effect of concept mapping on Biology students' academic performance in secondary schools in Etche ethnic nationality of Rivers State.

CONCLUSION AND RECOMMENDATIONS

This study investigated the effect of concept mapping, field-trip teaching methods and students' performance in Basic Science and Technology in Etim Ekpo, Akwa Ibom State, Nigeria. Basic Science and Technology performance test in light energy (BSTPTLE) was used for data collection. Two teaching packages (first, for concept map and second, for field-trip methods) were prepared by the researcher to teach light energy. The findings revealed a significant difference between the mean performance scores of Basic Science and Technology students when taught light energy using concept mapping and field-trip methods. Also, there was a significant difference between the mean performance scores of male and female students in Basic Science and Technology in the concept of light energy and there is no significant interaction between teaching methods and gender on students' academic performance in Basic science and technology. It was concluded that students' academic performance could be improved with a field trip rather than the concept map method. Based on these findings, it was recommended that the field trip method should be used in teaching light energy and other concepts in Physics.

Based on these findings, it is concluded that the field-trip method had a significant effect on academic performance and gender in Basic Science and Technology. This implies that the field-trip method increases students' performance more than the concept map method. Therefore, the following recommendations were made:

- i. Basic Science and Technology teachers should make effective use of the field-trip teaching method in teaching light energy and other concepts in Basic Science and Technology.
- ii. The field-trip teaching method should be integrated into the curriculum of Basic Science and Technology as one of the teaching methods for improved performance.

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