AJSTME, Volume. 12, Issue 1. 204-210, January, 2026. https://www.ajstme.com.ng
ISSN: 2251-0141 (Print), 2971-6233 (Online)

Effects of Concept Mapping Strategy on Students' Interest and Academic Performance in Basic Science, Benue State, Nigeria

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Abstract

This study investigated the effects of Concept Mapping (CM) instructional strategy on students' interest and academic performance in Basic Science among Upper Basic II students in Vandeikya Education Zone, Benue State, Nigeria. A pre-test, post-test quasi-experimental design was adopted with two groups: Experimental Group (CM, n=106) and Control Group (chalk-and-talk, n=106), drawn from a population of 13,009 students in 96 public schools. Multi-stage sampling yielded 321 students from three intact classes. Data were collected using the Basic Science Interest Questionnaire (BSIQ, Cronbach Alpha=0.86) and Basic Science Performance Test (BSPT, KR-20=0.79), validated by five experts and trial-tested on 40 students. Two research questions and two null hypotheses tested at 0.05 significance level guided the study. Data were analysed using mean, standard deviation, and ANCOVA. Findings revealed that CM significantly improved students' interest and academic performance compared to chalk-and-talk. The study therefore recommends integrating CM into classroom practice and providing professional development for teachers.

Key words: Academic performance, Concept Mapping, Student interest

Introduction

Science drives national progress, and this progress begins in the classroom. When students develop a genuine love for science early in their education, they are more likely to pursue science-related careers and contribute meaningfully to national development. Unfortunately, this is not happening in many Nigerian schools. The problem is not that science is being ignored; it is that science is being taught in ways that fail to excite or engage students. For many years, teachers have relied on the chalk-and-talk method, standing in front of the class, talking, and expecting students to listen and memorize. This approach leaves little room for students to think, question, or explore, and research has shown that students remember very little of what they are simply told (Dange, 2025). Despite its obvious limitations, this method continues because it is convenient and requires little preparation, but the damage it does to students' learning is considerable (Adeyemi & Olorundare, 2019; Amedu, Otuka, & Uzoechi, 2021).

Basic Science was introduced into Nigeria's junior secondary curriculum in 2012 to bring together concepts from Biology, Chemistry, and Physics under one subject, giving students a broad scientific foundation before they specialize at the senior level (Otor, 2022; Olarewaju, 2024). The curriculum was designed with the idea that students would learn through activities, experiments, and exploration. In reality, however, most Basic Science classrooms look nothing like what the curriculum envisioned. Teachers still do most of the talking while students sit passively, and this disconnect between what the curriculum recommends and what actually happens in classrooms is one of the key reasons students continue to struggle with the subject (Katcha & Babagana, 2022; Agboghoroma, 2024).

Concept Mapping has attracted considerable attention as a more effective instructional alternative. Developed from Ausubel's idea that people learn best when they connect new information to what they

already know, concept mapping asks students to draw diagrams that show how scientific ideas relate to one another (Novak, 1990; Caniglia, 2019). Rather than copying notes from a board, students using concept maps actively think about what they are learning, organize ideas in their own way, and identify connections that might not be obvious from a textbook. This kind of active mental engagement has been shown to produce deeper and more lasting understanding than passive note-taking (Otor, 2013; Ajaja, 2021). Additionally, the maps students produce give teachers a window into how their students are thinking, making it easier to identify and correct misconceptions before they become entrenched.

Student interest plays a bigger role in learning than many people realize. A student who finds a subject interesting will pay more attention, put in more effort, and retain more information than one who finds it boring or irrelevant. Importantly, interest in science is not something students are simply born with or without; it develops or fades depending on how the subject is taught (Anderson, 2017; Okonkwo & Nwagbo, 2024). When lessons are connected to real life and students are given opportunities to participate actively, interest grows. When lessons are dry, abstract, and one-directional, interest disappears (Ojukwu, 2016; Ajai & Ogbeba, 2017). Research consistently shows that the quality of teaching matters far more than students' background in determining how interested they become in a subject (Chambers, 2018; Gipps, 2024).

Academic performance in Basic Science across Benue State paints a worrying picture. Over a ten-year period from 2015 to 2024, the proportion of students passing the Basic Education Certificate Examination never rose above 31.67% and at times fell as low as 19.20%, with failure rates reaching 56% (Benue State Examination Board, 2024). These numbers represent real students leaving basic education without the scientific foundation they need. Topics such as energy transformation, atomic structure, and chemical reactions are repeatedly flagged as areas where students struggle most (Tamarin, 2017; Amoebi, 2017), pointing to an instruction problem rather than a student problem. Yet despite this ongoing crisis, very few studies have systematically examined whether student-centered strategies like Concept Mapping can reverse this trend in Benue State specifically. This study was therefore designed to fill that gap by investigating the effect of Concept Mapping on the interest and academic performance of Upper Basic II students in Vandeikya Education Zone, with the aim of providing practical, evidence-based guidance for teachers and education policymakers in the region.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean interest ratings of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method?
2. What is the difference between the mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method?

Hypotheses

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

1. There is no significant difference between the mean interest ratings of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method.
2. There is no significant difference between the mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method.

Methodology

A non-equivalent pre-test post-test control group quasi-experimental design was adopted because intact classes were used, as school schedules could not be disrupted. This design enabled comparison of Concept Mapping against chalk-and-talk while controlling for pre-existing group differences. The population comprised 13,009 Upper Basic II students aged 12 to 15 years in 96 public schools across four LGAs in Vandeikya Education Zone for the 2024/2025 academic session. A multi-stage sampling procedure yielded a sample of 212 students: 106 in the Concept Mapping group and 106 in the Control group, drawn from two intact classes in two schools selected from two LGAs. Data were collected using the Basic Science Interest Questionnaire (BSIQ) and the Basic Science Performance Test (BSPT). The BSIQ contained 36 items rated on a four-point Likert scale, while the BSPT comprised 50 multiple-choice items adapted from BECE and NECO past questions (2020-2024), covering NERDC-prescribed topics relevant to Upper Basic II students. Both instruments were face and content validated by five experts, whose recommendations were

incorporated to improve clarity, cognitive balance, distractor quality, and alignment with instructional strategy principles. Reliability was established through a trial test on 40 students, yielding Cronbach Alpha of 0.86 for the BSIQ and KR-20 of 0.79 for the BSPT, both indicating high internal consistency. Data collection spanned seven weeks. Pre-tests were administered in week one, followed by five weeks of instruction, and post-tests in week seven. Six trained research assistants with at least five years of teaching experience administered the instruments under standardized conditions. Data were analysed using mean, standard deviation, and ANCOVA at 0.05 significance level. Extraneous variables were controlled through pre-testing for baseline equivalence, content uniformity via researcher-developed lesson plans, standardized training of research assistants, one-strategy-per-school arrangement to prevent treatment contamination, and selection of co-educational schools to balance gender as a co-variable.

Results

Research Question 1

Table 1: Mean and Standard Deviation of mean interest ratings of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method

Method	N	Pre-interest		Post-interest		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Concept Mapping (CM) (Experimental Group)	106	1.82	.86	2.79	.93	0.97
Chalk and talk method (Control Group)	106	1.83	.856	2.05	.989	0.22
Mean Difference						0.75

Table 1 shows the mean interest ratings of students taught Basic Science using Concept Mapping (CM) strategy and those taught using the chalk and talk method. The table reveals that the mean interest rating of students taught with CM was 1.82 with a standard deviation of 0.86 at pre-interest, while their post-interest mean rating was 2.79 with a standard deviation of 0.93. Conversely, the mean interest rating of students taught using the chalk and talk method was 1.83 with a standard deviation of 0.856 at pre-interest, and a post-interest mean rating of 2.05 with a standard deviation of 0.989. Furthermore, the table shows that the students taught with the CM strategy had a mean gain of 0.97, while those taught using the chalk and talk method had a mean gain of 0.22. The mean difference between the post-interest ratings of students taught Basic Science using CM strategy and those taught with chalk and talk method was 0.75 in favour of the CM strategy. This indicates that students exposed to Concept Mapping strategy developed greater interest in Basic Science compared to their counterparts taught using the chalk and talk method.

Research Question 2

Table 2: Mean and Standard Deviation of mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method

Method	N	Pre-test		Post-test		Mean gain
		$\bar{x}$	SD	$\bar{x}$	SD	
Concept Mapping (CM) (Experimental Group)	106	25.25	8.59	40.42	6.41	15.17
Chalk and talk method (Control Group)	106	25.30	8.86	28.17	9.89	2.87
Mean Difference						12.25

Table 2 shows the mean academic performance scores of students taught Basic Science using Concept Mapping (CM) strategy and those taught using the chalk and talk method. The table reveals that the mean performance score of students taught with CM was 25.25 with a standard deviation of 8.59 at pre-test, while their post-test mean score was 40.42 with a standard deviation of 6.41. Conversely, the mean performance score of students taught using the chalk and talk method was 25.30 with a standard deviation of 8.86 at pre-test, and a post-test mean score of 28.17 with a standard deviation of 9.89. Furthermore, the results show that students taught with the CM strategy had a mean gain of 15.17, while those taught with the chalk and talk method had a mean gain of 2.87. The mean difference between the post-test scores of students taught Basic Science using CM strategy and those taught with chalk and talk method was therefore 12.25 in favour of the CM strategy. This indicates that students exposed to the Concept Mapping strategy performed better academically in Basic Science than those taught with the chalk and talk method. The mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method illustrated in Figure 5.

Hypotheses

Hypothesis One

There is no significant difference between the mean interest ratings of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method.

Table 3: ANCOVA on mean interest ratings of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	72.849[a]	2	36.425	50.486	.000
Intercept	80.257	1	80.257	111.241	.000
Pre-interest	43.410	1	43.410	60.169	.000
Strategy	29.834	1	29.834	41.352	.000
Error	150.788	209	.721		
Total	1465.000	212			
Corrected Total	223.637	211			

a. R Squared = .326 (Adjusted R Squared = .319)

Table 3 reveals that F (1, 209) = 41.352; p = 0.000 < 0.05. Since the p-value is less than the 0.05 alpha level, the null hypothesis is rejected. This shows that the teaching strategy had a significant effect on students' interest in Basic Science. Hence, there is a significant difference between the mean interest ratings of students taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method. The R Squared value of 0.326 indicates that about 32.6% of the variance in students' interest ratings can be explained by the teaching strategy and pre-interest scores. This suggests a moderate effect size. Therefore, based on evidence from data analysis, it is concluded that the Concept Mapping (CM) strategy significantly enhanced students' interest in Basic Science when compared with the chalk and talk method.

Hypothesis Two

There is no significant difference between the mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method.

Table 4: ANCOVA on mean academic performance scores of students in Basic Science taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12817.532[a]	2	6408.766	137.854	.000
Intercept	9259.705	1	9259.705	199.178	.000
Pretest	4870.343	1	4870.343	104.762	.000
Strategy	7980.958	1	7980.958	171.672	.000
Error	9716.336	209	46.490		
Total	271840.000	212			
Corrected Total	22533.868	211			

a. R Squared = .569 (Adjusted R Squared = .565)

Table 4 shows that $F(1, 209) = 171.672$; $p = 0.000 < 0.05$. Since the p-value is less than the alpha level of 0.05, the null hypothesis is rejected. This indicates that the teaching strategy had a significant effect on students' academic performance in Basic Science. Thus, there is a significant difference between the mean academic performance scores of students taught using Concept Mapping (CM) strategy and those taught using the chalk and talk method. The R Squared value of 0.569 implies that approximately 56.9% of the variance in students' academic performance can be explained by the teaching strategy and pretest scores. This shows a strong effect size. Therefore, based on empirical evidence, it is concluded that the Concept Mapping (CM) strategy significantly improved students' academic performance in Basic Science when compared with the chalk and talk method.

Discussion of Findings

The study revealed that there was a significant difference between the mean interest ratings of students in Basic Science taught using the Concept Mapping strategy and those taught using the chalk-and-talk method, with students in the Concept Mapping group demonstrating greater interest. Students exposed to Concept Mapping were found to develop higher levels of enthusiasm and engagement than those taught using the conventional method. This may be because the visual and interactive nature of Concept Mapping sustained learners' attention and curiosity, allowing students to identify key ideas, link related concepts, and take ownership of their learning, unlike the chalk-and-talk method which emphasizes teacher-centered delivery and rote memorization. This finding aligns with Ibok (2020), Wokocha (2020), Adigwe (2024), and Woldeamanuel et al. (2025), who reported that students taught using Concept Mapping developed greater enthusiasm, motivation, and sustained curiosity toward science compared to those taught through traditional methods. However, this finding contradicts Auta (2021), who reported no significant difference in students' interest when exposed to Concept Mapping and inquiry-based strategies in Physics, possibly due to differences in educational levels and subject content. The implication is that effective enhancement of students' interest in Basic Science requires the adoption of learner-centered strategies such as Concept Mapping that promote visual representation, meaningful connections, and active engagement, rather than relying solely on passive, teacher-dominated instructional approaches.

The study further revealed that there was a significant difference between the mean academic performance scores of students in Basic Science taught using the Concept Mapping strategy and those taught using the chalk-and-talk method, with students in the Concept Mapping group achieving higher academic performance. Students exposed to Concept Mapping were found to demonstrate superior understanding, mastery, and application of Basic Science concepts than those taught with the conventional method. This may be because Concept Mapping promotes meaningful learning by enabling students to visualize relationships among ideas and integrate new knowledge into existing cognitive frameworks, thereby deepening comprehension and enhancing retention. Unlike the chalk-and-talk method, which relies on rote memorization and passive listening,

Concept Mapping encourages active participation, critical thinking, and self-directed learning through hierarchical organization of information and reflective thinking. This finding aligns with Uzowulu (2021), Auta (2021), Magaji (2024), and Bizimana (2024), who independently reported that Concept Mapping significantly improved students' achievement, retention, and understanding in science-related subjects by encouraging integration of concepts, forming clearer conceptual links, promoting active engagement, and fostering long-term knowledge transfer. The implication is that improving students' academic performance in Basic Science requires the implementation of instructional strategies like Concept Mapping that foster meaningful learning and conceptual understanding, highlighting the need for curriculum planners and educators to adopt active, learner-centered approaches that promote deeper cognitive engagement.

Conclusions

Based on the findings of this study, the following conclusions were drawn:

Findings from this study have shown that the use of learner-centered instructional strategies, such as Concept Mapping (CM), in teaching Basic Science at the Upper Basic II level was more effective than the conventional chalk-and-talk method in enhancing students' interest and academic performance.

Recommendations

i. Basic Science teachers should regularly adopt CM to stimulate students' active participation, as it enhances interest and improves academic performance compared to the chalk-and-talk method.
ii. Curriculum planners should incorporate CM-based activities in Basic Science lesson plans, as CM boosts students' interest over traditional methods.

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