Education Annals (2025), 2(7):233-241
https: doi.org /10.5281/zenodo.17023185
Research Article

Concept Mapping Teaching Strategy and Students' Interest in Basic Science in Makurdi, Benue State, Nigeria

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Received 11 August 2025; Acceptance 29 August 2025; Published 1 September 2025 2025.

Abstract

This study investigated the effectiveness of concept mapping teaching strategy on students' interest in Basic Science in Makurdi, Benue State, Nigeria. Non-randomized, non-equivalent quasi-experiment design was used for the study. Two research questions and two hypotheses guided the study. The population of the study was 8551 upper basic II students of 2024/2025 academic session comprising 4001 male and 4550 male students. Multi-stage sampling technique was employed to select a sample of 286 (138 male and 148 female)*. Six intact classes constituted the sample. The instrument used for the study –Basic Science Interest Scale (BSIS) was developed by the researchers and validated by three experts in Science Education, Measurement and Evaluation from Rev. Fr. Moses Orshio Adasu University, Makurdi. The instrument was trial tested on 40 students and it yielded reliability coefficient of 0.97 through Cronbach alpha. Data collected were analysed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings revealed a statistically significant difference between the mean interest ratings of students taught using concept mapping teaching strategy and conventional strategy (F1, 283) = 332.136; ρ = 0.000 < 0.05). The findings also revealed significant difference between the mean interest ratings of male and female students taught using concept mapping teaching strategy (F1, 149) = 4.869; ρ = 0.029 < 0.05). Based on the findings of this study, it was recommended among others that teachers should adopt concept mapping teaching strategy in teaching Basic Science to improve students' interest in the subject.*

Keywords*: Concept mapping, Interest, Gender, Basic science.*

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Introduction

Education is a vital tool used to achieve social, economic and scientific development of nations and science plays a key role different spheres of development. Effective teaching and learning of science lays the foundation for innovations and breakthroughs in medicine, agriculture, communication, technology among other vital sectors. In Nigeria education system, science is taught among other subjects such as Physics, Chemistry, Biology, Agricultural science and Basic Science.

Basic Science is the core science subject offered at the basic education level in Nigeria. Ode, Tanko and Adole (2023) referred to it as a subject in which the concepts and principles of science are presented to express the wholeness of scientific thought and to de-emphasize distinctions among scientific fields. It is the foundational science taught to children at the cradle in basic schools with the intent of laying a solid footing on which the rest of scientific studies at the post-basic and tertiary school levels would be built. Basic Science provides children with factual and practical knowledge about themselves and their environment which makes them understand the connection between science and their natural environment. In the National Policy on Education (FRN, 2014), government emphasized the essence of basic education which includes preparation for further studies at post-basic education and beyond.

Basic Science was introduced into Nigerian schools to introduce leaners to the culture of science (learning by doing) through active engagement of students in learning to encourage problem-solving and break cross-disciplinary boundaries among science subjects (Ode, Tanko & Adole, 2023). However, as Sagiru (2015), Agogo and Ode (2017) observe, these objectives are difficult to achieve due to factors such as poor teaching methods being used by teachers and low student interest in the subject. Despite the important role which Basic science plays in the life of students and national socio-economic development, the academic performance of students in Basic Science external examinations such as Basic Education Certificate Examination (BECE, 2015-2024) has been quite unsatisfactory over the last nine years. The consistent decline in students' performance has been attributed to poor interest and this calls for question on the effectiveness of the teaching strategies teachers use in teaching science subject (Ezugwu, Mbonu-Adigwe, Ibenegbu, & Okoye, 2022). Many students struggle to grasp scientific concepts effectively which could be as a result of poor interest in science.

Interest in learning is a key affective psychological trait. Kpolovie, Joe and Okoto (2014) viewed interest as an overwhelming magnetic positive feeling, a sense of being captivated, enthralled, invigorated and energized to cognitively process information much faster and more accurately. In the opinion of Matsum (2017), interest is a positive feeling that motivates a learner to have a propulsion, or being energised in learning. Drive towards engaging in certain events and the urge to avoid some events lie in the realm of interest. The adoption of innovative instructional strategy like concept mapping could lead to the development of students' interest in Basic Science.

Ode and Tartenger (2021) affirms as that the use of defective and passive conventional teaching strategy accounts for poor interest of students in science subjects. This strategy often fail to simplify complex and difficult science concepts since it does not engage students in meaningful learning experiences. This could

be minimized with the use of concept mapping. Ullah, Munir and Ahmad (2021) stated that concept mapping is a pedagogical/metacognitive tool, involving diagram showing the relationships among concepts designed to help students learn with flow of thought. Concept mapping has been adequately advocated in literature as a strategy for meaningful learning of abstract concepts and assists students to learn about conceptual changes (Kpiranyam, Achor & Fakaa, 2024). It is a graphical tool for organising and representing knowledge and a valuable resource with organizing and structuring knowledge. Conceptual maps enable students to represent their understanding of domain knowledge in a well-organised format which may stimulate male and female students' interest.Gender is another factor that is often linked to students' learning outcomes in science-related subjects. It is a socio-cultural construct that defines the roles, expectations, and characteristics associated with males and females within a society. In the context of education, gender differences have been widely studied to understand their influence on students' learning experiences and achievements. However, research on how gender impacts students' interest in science has yielded mixed findings, with no clear consensus on its effects. For instance, significant difference was not recorded between male and female students taught Basic Science (Naakaa & Ogbeba, 2018). Okechukwu and Opara (2021) found that gender has significant difference in interest of students exposed to Basic Science and Technology using team teaching strategy in favour of boys. However, Baba, Jumma and Zachariah (2022) found no significant gender difference in the interest of students in Basic Science while in the study by Dahiru (2013) females performed better than males. The inconsistency in the findings on gender calls for further research and this justifies its inclusion in this present study. However, in Makurdi metropolis of Benue State, Nigeria, there is paucity of empirical studies based on literature evidence available to the researchers on concept mapping and students' interest in Basic science. It was against this backdrop that the study was conducted to investigate the effect of concept mapping teaching strategy on students' interest in Basic science in Makurdi, Benue State, Nigeria.

Research Questions

The following research questions guided the study:

1. What is the difference between mean interest ratings of upper basic II students taught with concept mapping teaching strategy and those taught with chalk and talk strategy?
2. What is the difference between the mean interest ratings of male and female upper basic II students taught with concept mapping teaching strategy?

Hypotheses

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

1. There is no significant difference between the mean interest ratings of upper basic II students taught with concept mapping teaching strategy and those taught with chalk and talk strategy

2. There is no significant difference between the mean interest ratings of male and female upper basic II students taught with concept mapping teaching strategy

Research Method

The study adopted a quasi-experimental design of non-equivalent, non-randomized, pre-test/post-test control group. This design was considered appropriate because it allows for the comparison of outcomes between two groups (experimental and control) without random assignment of participants. According to Emaikwu (2019), quasi-experimental designs are appropriate in educational research where randomization is not feasible in order not to disrupt class organization, hence intact classes were used. The population of the study comprised 8,551 Upper Basic II students in UBE secondary schools in Makurdi, Benue State. Multi-stage sampling procedure was used to select 286 (138 male and 148 female) students from six schools in the study area. The criteria used for selection of the schools were that: they must have a qualified Basic Science teacher of not less than five years teaching experience and at least a B. Sc (Ed) or B. Ed in Integrated Science, the school must have BECE center and co-educational because of the gender variable. One intact class each in the six sampled schools were used and out of the six, three each were randomly assigned to experimental and control groups for the study.

The students in the experimental groups were taught with the concept mapping teaching strategy while the control groups were taught using the conventional teaching strategy. The instrument used for data collection was Basic Science Interest Scale **(**BSIS) developed and validated. The instrument was given to two science education experts and one specialist in measurement and evaluation, Benue State University, Makurdi for validation. The suggestion from their observation was effected before taking it to the field. The BSIS had two sections, section A contains the background information on the respondents (class, time allowed and gender) while section B contains the 30 items with the following responses: Strongly Agree (4 points), Agree (3 points), Disagree (2 points) and Strongly Disagree (1 point) for positive items; the scoring was in reverse order for negative items. The trial-testing was carried out 40 students in a school within the study are that was not part of the sampled schools to determine the internal consistency of the instrument. The result of the data analyzed using Cronbach alpha yielded a reliability coefficient of 0.97, this statistic was used because the items in the instrument were not scored dichotomously.

Trained research assistants (Basic Science teachers in the sampled schools) administered the pre – test to the students that participated in the study. Thereafter, the research assistants' taught the topics work energy and power to the experimental group using concept mapping strategy while conventional teaching strategy was used for the control group. The treatment lasted for four weeks after which a post- test was administered to the students. Mean and standard deviation were used to answer the research questions. Analysis of Covariance (ANCOVA) was used to test the formulated hypotheses at 0.05 level of significance. The choice of ANCOVA was due to the fact that it statistically removes the initial differences across the non- randomized groups (Emaikwu, 2019).

Results and Discussion

The results are presented based on the research questions and hypotheses of the study as follows:

Research Question One

What is the difference between mean interest ratings of upper basic II students taught with concept mapping strategy and those taught with chalk and talk strategy?

Table 1. Mean Interest Ratings of Students Taught Basic Science using Concept Mapping Strategy and those Taught with Conventional Strategy.

Group	Sample (n)	Pretest		Posttest		Mean gain
		Mean	Std. D.	Mean	Std. D.	
Concept Mapping Strategy	152	1.88	0.42	3.03	0.47	**1.15**
Conventional	134	1.95	0.45	2.01	0.50	**0.06**
Mean Difference		**0.07**		**1.02**		**1.09**
Total	**286**					

Table 1 shows that the mean interest rating scores of students taught Basic Science using concept mapping strategy was 1.88 with standard deviation of 0.42 during pre-test. It also shows mean value of 3.03 with standard deviation of 0.047 in the post-test. The mean interest ratings of students taught Basic Science using conventional method was 1.95 with standard deviation of 0.45 during pre-test. In posttest the mean value was 2.01 with standard deviation of 0.50. Table 1 further reveals that the mean gain of students taught Basic Science using concept mapping strategy was 1.15, while those taught using conventional method had a mean gain of 0.06. The mean difference interest between the groups was 1.09 in favour of students taught using Basic Science using concept mapping strategy.

Research Question Two

What is the difference between the mean interest ratings of male and female upper basic II students taught with concept mapping strategy?

Table 2. Mean Interest Ratings of Male and Female Students Taught Basic Science using Concept Mapping Strategy.

Gender	Sample (n)	Pretest		Posttest		Mean gain
		Mean	Std. D.	Mean	Std. D.	
Male	80	1.87	0.42	3.11	0.43	**1.24**
Female	72	1.88	0.41	2.94	0.49	**1.06**

Mean Difference		**0.01**	**0.17**	**0.18**
Total	**152**			

Data in Table 2 indicates that the mean interest rating scores of male taught Basic Science using concept mapping strategy was 1.87 with standard deviation of 0.42 at pre-test. It also shows mean value of 3.11 with standard deviation of 0.343 in post-test. Table 4 also indicates that the mean interest ratings of female taught Basic Science using concept mapping strategy was 1.88 with standard deviation of 0.41 at pre-test. It also shows mean value of 2.94 with standard deviation of 0.49 in post-test. Table 2 also revealed that the mean gain of male students taught Basic Science using concept mapping strategy was 1.24, while that of female students was 1.06. The mean gain difference of performance between male and female was 0.18 in favour of male students taught Basic Science using concept mapping strategy

Hypothesis 1

There is no significant difference between the mean interest ratings of upper basic II students taught with concept mapping strategy and those taught with chalk and talk strategy.

Table 3. Result of ANCOVA on Interest Ratings of Students Taught Basic Science Using Concept Mapping Strategy and those Taught with Chalk and Talk Strategy.

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	76.012[a]	2	38.006	167.239	.000	.542
Intercept	63.451	1	63.451	279.206	.000	.497
PreInterest	2.062	1	2.062	9.072	.003	.031
Strategy	**75.480**	**1**	**75.480**	**332.136**	**.000**	**.540**
Error	64.313	283	.227			
Total	1999.938	286				
Corrected Total	140.325	285				

a. R Squared = .542 (Adjusted R Squared = .538)

ANCOVA Result in Table 3 reveals that $F(1, 283)= 332.136$; $\rho = 0.000 < 0.05$. Thus, the null hypothesis was rejected. This implies that, there was a significant difference in the mean interest ratings scores of students taught Basic Science using concept mapping strategy and those taught using conventional method. Thus, based on evidences from data analysis, concept mapping strategy significantly enhanced students' interest than those students taught conventional method.

Hypothesis 2

There is no significant difference between the mean interest ratings of male and female upper basic II students taught with concept mapping teaching strategy

Table 4. ANCOVA Result on Mean Interest Ratings of Male and Female Students taught Basic Science using Concept Mapping Strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.035[a]	2	.518	2.435	.091	.032
Intercept	64.232	1	64.232	302.069	.000	.670
PreInterest	.001	1	.001	.006	.940	.000
Gender	**1.035**	**1**	**1.035**	**4.868**	**.029**	**.032**
Error	31.683	149	.213			
Total	1425.793	152				
Corrected Total	32.719	151				

a. R Squared = .032 (Adjusted R Squared = .019)

ANCOVA Result Table 4 reveals that $F(1, 149) = 4.869$; $\rho = 0.029 < 0.05$. Since $\rho < 0.05$, the null hypothesis was rejected. It thus implies that, there was significance difference in the mean interest ratings of male and female students taught Basic Science using concept mapping strategy. Based on evidence from data analysis, interest ratings of male and female students taught Basic Science using concept mapping strategy improved significantly with gender disparity.

Discussion of Findings

The result of the study reveals that there is a significant difference in the mean interest ratings of students taught Basic Science with concept mapping strategy and those taught conventionally. This implies that the concept mapping strategy improved students' interest in Basic Science than the conventional strategy. This could be due to the fact that concept maps provides visual representation of complex relationship between ideas, making it easier for students to organize and understand concepts. Concept maps engender meaningful learning by encouraging critical thinking, analysis and evaluation of information through visualization of relationship between concepts leading to enhanced retention of learning experiences and improved interest. This finding agrees with that of Ullah, Munir and Ahmed (2021) who found concept mapping strategy to the effective in improving students' interest in learning. This finding concord with that of Ode and Tartenger (2021) who found that students' interest was enhanced using concept mapping strategy.

Findings also indicates a significant difference between the mean interest ratings of male and female students taught Basic Science using the concept mapping strategy. The finding agrees with the findings of Okechukwu and Opara (2021) found that gender has significant difference in interest of students exposed to Basic Science. However, it disagrees with that of Baba, Jumma and Zachariah (2022) who found no significant gender difference in the interest of students in Basic Science. The disagreements of the findings could be due to variation in study location and research subjects. The educational implications of the findings is that concept mapping teaching strategy is capable of improving students' interests in Basic Science; gender gap in students' interest in Basic Science cannot be bridged with the use of concept mapping teaching strategy.

Conclusion

This study concludes that the use of concept mapping strategy significantly enhances students' interest in learning Basic Science, though it does not create gender-based differences in interest. It is therefore recommended that Basic Science teachers adopt concept mapping as a core instructional strategy, while school administrators and inspectors ensure its consistent application. Furthermore, Ministries of Education and other stakeholders should promote its use by organizing seminars, workshops, and conferences to equip teachers with the necessary skills for effective implementation, thereby fostering sustained student engagement in Basic Science.

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