Nurturing Secondary Schools Students' Academic Interest in Biology using Mind Mapping Instructional Strategy

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DOI: https://dx.doi.org/10.47772/IJRISS.2023.701067
Received: 09 October 2023; Accepted: 18 October 2023; Published: 03 November 2023

ABSTRACT

The study investigated the effect of mind mapping instructional strategy (MMIS) on secondary school students' academic interest in biology in Awka Education Zone. Two research questions and three null hypotheses tested at 0.05 alpha levels guided the study. The study is quasi-experimental, adopting the non-randomized control group research design. A sample size of 124 (58 males and 66 females) Senior Secondary year one (SS1) students, drawn from the 3,411 SS1 students in Awka Education Zone, Anambra State, Nigeria, using multi stage sampling procedure were the research participants. The sampled students who were in four intact classes were randomly assigned to experimental (33 boys and 40 girls) and control groups (25 boys and 26 girls) using a flip of a coin. A 30-item Biology students' interest scale (BSIS), with four response options, adapted from Knekta, Rowland, Corwin, and Eddy's (2020), was used for data collection. BSIS was validated by three experts and with reliability index of 0.74 established using Cronbach alpha. Data collected, from the administered scales, were analyzed using mean and standard deviation to answer the research questions and Analysis of Covariance (ANCOVA) to test the null hypotheses at 0.05 alpha level. The findings of the study revealed that MMIS is more effective in fostering students' interest in biology than CLM, irrespective of gender. Also, no interaction effect of teaching methods and gender on students' interest was found. The study therefore concluded that MMIS is a gender friendly approach that fosters students' interest in biology as it uses lines, symbols, keywords, colour and images that appeals to a student's present knowledge. Based on the findings, recommendations were made among which include that MMIS should be adopted by biology teachers in schools to foster students' interest in biology.

Keywords: Mind Mapping Instructional Strategy (MMIS), Academic Interest, Biology, Gender

INTRODUCTION

Teaching and learning of biology for improved academic performance in a 21st century classroom has been marred by many factors that influences the teaching and learning process. These factors broadly classified by Nwuba et al (2023a) as environmental and psychological (personal) have been identified by many as the major causes of biology students' unsatisfactory and inconsistent performance in external examinations, evidently shown by West African Examinations Council (WAEC) statistics reports on biology from 2017-2021. That is, for 2017, for aggregate of A_1-C_6, a percentage pass of 55.57 was recorded, 55.10% in 2018, 55.63% in 2019, 63.23% in 2020 and 58.09% in 2021.

In an attempt to curtail this ugly trend of unsatisfactory performance, several empirical studies have been carried out on biology to identify these factors and their implications. Adebanjo (2019), Nwuba and Osuafor (2021), and Nwuba et al (2023a) in their respective studies in biology identified environmental variables like teacher-related factors, teaching methods and strategies, unconducive learning environment, non-availability of instructional materials for teaching, absence of equipped biology laboratories in schools, inadequate science equipment for practical lessons, high student-teacher ratio (large class size), cumbersome nature of the secondary school biology curriculum as the major factors that limit students' participation in

biology classes to promote meaningful learning. Similarly, others (Attamah & Okoli, 2021; Nwosu & Samuel, 2022; Nwuba et al., 2022, Nwuba et al., 2023b), in their respective studies, also in biology, identified achievement, motivation, self-efficacy, reading habits, locus of control, interest, creativity, communication skills, critical thinking and test anxiety as students personal (psychological) variables that needs to be developed and fostered, if students' achievement is expected to increased significantly and remain positively consistent. Considering this, the researchers' identified academic interest as a personal variable that may influence a student's academic achievement in biology and thus advocated for the utilization of MMIS to foster students' interest in biology classrooms.

Interest is a sensation that draws one's attention to a certain thing, activity or process. Nwuba et al (2023b) defined it as a personal attribute of a student towards a learning situation usually expressed as like or dislike. Interest is the focusing of the sense organs on or giving attention to some person, activity, situation and object (Essien et al., 2015). Hence, academic interest, in the context of the study, simply refers to a student's willingness or zeal to partake in a learning activity. Academic interest in education has drawn the attention of education stakeholders as it has been identified as an important factor that needs to be considered for effective learning to take place. This may be why Ugwuanyi (2010) posited that interest helps in sustaining concentration, purpose, commitment and co-operation with the teacher in the learning process, and as a result the strongest strength for predicting performance. Supporting the premise, Udoh (2019) stated that meaningful learning depends on interest and how motivated learners are during the teaching and learning scenarios as when students feel passionate about a lesson content and its method of instruction, the student's interest is aroused. In light of this, the study advocated for the utilization of mind mapping instructional strategy (MMIS) to determine its effect on secondary school students' interest in biology.

Mind-mapping, popularized by a psychologist Tony Buzan in 1974, in the simplest sense is a vital tool that is used to organize information. Kanelechi et al (2018) defined MMIS as a powerful graphic technique which harnesses the full range of cortical skills such as word, image, number, logic, rhythm, colour and spatial awareness in a single, powerful manner. It is an innovative approach that uses different maps to connect information on a concept (Osuafor & Anenye, 2023). In using mind-mapping teaching strategy, Osuafor and Anenye stressed that mind maps are created around a single concept, drawn in the center of a blank page, to which associated representations of ideas such as images, words and parts of words are added which form branches. That is, major ideas are directly connected to the central concept while supporting ideas branch out from major ideas radially from the central theme.

When effectively implemented, MMIS has been known to create a meaningful link and connections between the mind and ideas in the classroom. Supporting the premise, Kamelia et al (2018) stated that it is a powerful tool commonly used by psychologist, educationist and other professionals in brainstorming, note taking, problem solving, memory learning and visual thinking situations. Myre (2021), in the same vein, posited that mind-mapping by the essence of its characteristics is a useful strategy for introducing new ideas, as it is a powerful creative exercise for brainstorming ideas and finding connections. Summarizing these benefits, Fujiawati (2016) stated that mapping is a good way for students to understand and remember a number of new information as it promotes greater creativity for all students; giving them freedom to roam the infinite expanses of the brain to think and develop their conceptual schema, assimilate new information and foster their interest in the long run, especially in science subjects like biology.

Biology is one of the science subjects taught at the senior secondary school level in Nigeria. Nwuba et al (2023b) defined it as a branch of science that studies living things and their interactions with the environment. It is a branch of natural science concerned with all the varied aspects of living organisms (Abimbola & Abidoye, 2013). Hence, biology can simply be defined as a natural science concerned with living organisms and their characteristics. Considering these definitions, one can posit that the importance of biology cannot be overstated. Bamidele and Yaode (2017) stated that the learning of Biology provides an

individual with useful information in solving everyday life challenges. Biology prepares students to undertake further studies and eventually build careers in such scientific fields as medical sciences and allied fields, pharmaceutical sciences, environmental Biology, biotechnology, plant and animal sciences/ husbandry, agricultural sciences, food sciences, among others (Onu et al., 2020). In light of these importance of biology to man, industrialization and understanding of the environment, the study advocated for the utilization of MMIS in fostering students' interest in the subject for enhanced academic achievement, irrespective of gender.

Gender is a socio-cultural construct that assigns roles, attitudes and values considered appropriate for each sex (Godpower-Echie & Owo, 2019). Obikezie et al (2023) defined it as a universally accepted attribute ascribed to male and female based on biological features. In recent times, issues related to gender in science education have generated serious concerns for science educators judging by the number of studies done to that effect. Still, there is no consensus as to whether it affects students' interest in science or not. While some researchers (Onu, Anyaegbumam & Uzoigwe, 2020; Usang & Okoli, 2021) reported that female students had higher interest in biology and chemistry respectively than their male counterparts, others (Nwuba et al., 2022; Okekeokosisi & Okigbo, 2021) reported that there is no significant difference in the mean interest scores of male and female students in science subjects. This inconclusive results on gender calls for further investigation to find out if gender influences students' interest in biology or not. Hence, this study also intends to bridge this gap by examining gender differences in interest among secondary school students' taught biology, when taught using MMIS.

Research Questions

To achieve the purpose of the study, the following research questions guided the study:

1. What is the difference between the mean interest scores of students taught Biology using Mind Mapping Instructional Strategy (MMIS) and those taught using Conventional Lecture Method (CLM)?
2. What are the differences between the mean interest scores of male and female students taught Biology using MMIS and CLM?

Hypotheses

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

1. No significant difference exists between the mean interest scores of students taught Biology using Mind Mapping Instructional Strategy (MMIS) and those taught using Conventional Lecture Method (CLM).
2. There is no significant difference between the mean interest scores of male and female students taught Biology using MMIS and CLM
3. There is no significant interaction effect of gender and teaching methods on students' interest in Biology.

METHOD

In this quasi-experimental study, a non-randomized control group design was employed. 3,411 SS1 students, in the 50 government-owned co-educational secondary schools in Awka Education Zone, Anambra State, Nigeria, made up the population of the study. The sample consists of 124 SS1 biology students (58 males and 66 females) drawn from four government co-educational secondary schools, in the zone under study, using multistage sampling procedure. A 30-item Biology Students' interest Scale (BSIS) adapted from Knekta, Rowland, Corwin, and Eddy's (2020) interest scale was used for data collection. The adapted BSIS, structured on a 4-point Likert-like response options of; Strongly Agree (4 points), Agree (3 points),

Disagree (2 points) and Strongly Disagree (1 point), was validated by three experts and administered to an intact class of 30 SS1 students in Onitsha Education zone, outside the study area, for pilot testing. Response scores from the pilot test, when estimated using Cronbach alpha, gave a reliability coefficient of 0.74, showing that the instrument was extremely reliable.

The manipulation of variables started with the biology teachers from the four sampled schools, who would function as research assistants, being briefed on two contacts before the treatment procedure. The teachers in the control groups were told to carry on as usual using the lesson plans for the Conventional Lecture Method (CLM), developed by the researchers, while the research assistant in the experimental groups were briefed on MMIS, its features, and how to efficiently administer the instructional method using the lesson plans created by the researchers. Following the briefing, the BSIS, which functioned as the pretest score, was given to the four drawn intact classes that were divided into the control (33 boys and 40 girls) and experimental (25 boys and 26 girls) groups. Following the pre-testing, the two groups began a 4-week long treatment (teaching) activity. After the instructional session, both groups completed a post-test, which was used to calculate the post-test score. In analyzing the collected data, mean and standard deviation were used to answer the research questions while ANCOVA was employed at the 0.05 alpha level for testing the null hypotheses.

RESULTS

Research Question 1: What is the difference between the mean interest scores of students taught Biology using MMIS and those taught using CLM?

Table 3: Mean and standard deviation on interest rating scores of students taught Biology using MMIS and those taught using CLM

		Pretest		Posttest		
Groups	N	Mean	SD	Mean	SD	Mean Gain
Experimental (MMIS)	51	73.76	9.47	98.94	6.52	25.18
Control (CLM)	73	78.44	8.81	92.58	9.38	14.14
Mean Difference		4.68		6.36		11.04

Table 1 shows that students taught Biology using MMIS had mean interest scores of 73.76 and 98.94 in their pretest and posttest respectively, with gained mean interest rating score of 25.18, while those in the control group taught with CLM had pretest mean interest rating score of 78.44 and posttest mean interest rating score of 92.58 with gained mean interest rating score of 14.14. The use of MMIS reduced the variation of score from 9.47 to 6.52 in the posttest interest rating. There was a low score variation in the posttest interest rating of MMIS group (6.52) compared to those taught Biology using CLM (9.38). The difference between the gained mean interest rating scores of the students was 11.04 in favour of MMIS. This implies that MMIS is more efficient in promoting students' interest in Biology than CLM.

Research Question 2: What are the differences in the mean interest rating scores of male and female students taught Biology using MMIS and those taught using CLM?

Table 2: Mean and standard deviation on interest rating scores of male and female students taught Biology using MMIS and those taught using CLM

Pre-test					Post-test		
Group	Gender	N	Mean	SD	Mean	SD	Mean Gain

MMIS	Male	25	74.20	7.97	98.20	6.71	24.00
	Female	26	73.35	10.86	99.65	6.37	26.30
	Mean Difference		0.85		1.45		2.30
CLM	Male	33	75.70	7.58	90.70	9.91	15.00
	Female	40	80.70	9.19	94.13	8.74	13.43
	Mean Difference		5.00		3.43		1.57

Table 2 shows that male students taught Biology using MMIS had pretest mean interest rating score of 74.20 and posttest mean interest rating score of 98.20 with gained mean interest rating score of 24.00, while females have pretest mean interest rating score of 73.35 and posttest mean interest rating score of 99.65 with gained mean interest rating score of 26.30. The use of MMIS reduced the variation of score among female students more than their male counterparts. The difference between the mean interest rating score of male and female students taught Biology using MMIS was 2.30 in favour of the female students. Moreover, Table 4 shows that male students taught Biology using CLM had pretest mean interest rating score of 75.70 and posttest mean interest rating score of 90.70 with gained mean interest rating score of 15.00, while females have pretest mean interest rating score of 80.70 and posttest mean interest rating score of 94.13 with gained mean interest rating score of 13.43. The use of CLM reduced the variation of score among female students more than their male counterparts. The difference between the mean interest rating score of male and female students taught Biology using CLM was 1.57 in favour of the male students.

Hypothesis 1: There will be no significant difference between the mean interest rating scores of students taught Biology using MMIS and those taught using CLM.

Table 3: Summary of the two-way ANCOVA test of significant difference between the mean interest rating scores of students taught Biology using MMIS and those taught using CLM

-Source-	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared	Decision
Corrected Model	2874.616[a]	4	718.654	12.579	.000	.297	
Intercept	7251.118	1	7251.118	126.918	.000	.516	
Pretest Interest	1418.491	1	1418.491	24.828	.000	.173	
Method	1902.760	1	1902.760	33.304	.000	.219	Sig.
Gender	79.731	1	79.731	1.396	.240	.012	NS
Method * Gender	.556	1	.556	.010	.922	.000	NS
Error	6798.739	119	57.132				
Total	1133338.000	124					
Corrected Total	9673.355	123					

Table 3 shows that F (1, 119) = 33.304, P = 0.000 < 0.05 alpha level, therefore, hypothesis 1 was rejected. The inference drawn is that there is a significant difference between the mean interest rating scores of students taught Biology using MMIS and those taught using CLM. This is in favour of the MMIS group. In term of effect size, Table 3 shows that Partial Eta Squared .219 (21.9%) in interest scores of students is attributed to the treatment.

Hypothesis 2: There will be no significant difference between the mean interest rating scores of male and female students taught Biology.

Table 3 shows that F (1, 119) = 1.396, P = 0.240 > 0.05 alpha level, therefore, the hypothesis 2 -was not rejected. The inference drawn is that there is no significant difference between the mean interest rating

scores of male and female students taught Biology. In term of effect size, Table 3 shows that Partial Eta Squared .012 (1.2%) in interest scores of students is attributed to effect of gender.

Hypothesis 3: There will be no significant interaction effect of gender and teaching method (MMIS and CLM) on interest of students in Biology.

Table 3 shows that F (1, 119) = 0.010, P = 0.922 > 0.05 alpha level, therefore, hypothesis 3 was not rejected. The inference drawn is that there is no significant interaction effect of gender and teaching method (MMIS and CLM) on interest of students in Biology. In term of effect size, Table 3 shows that Partial Eta Squared .00 (0.00%) in interest scores of students is attributed to the interaction effect of gender and teaching method.

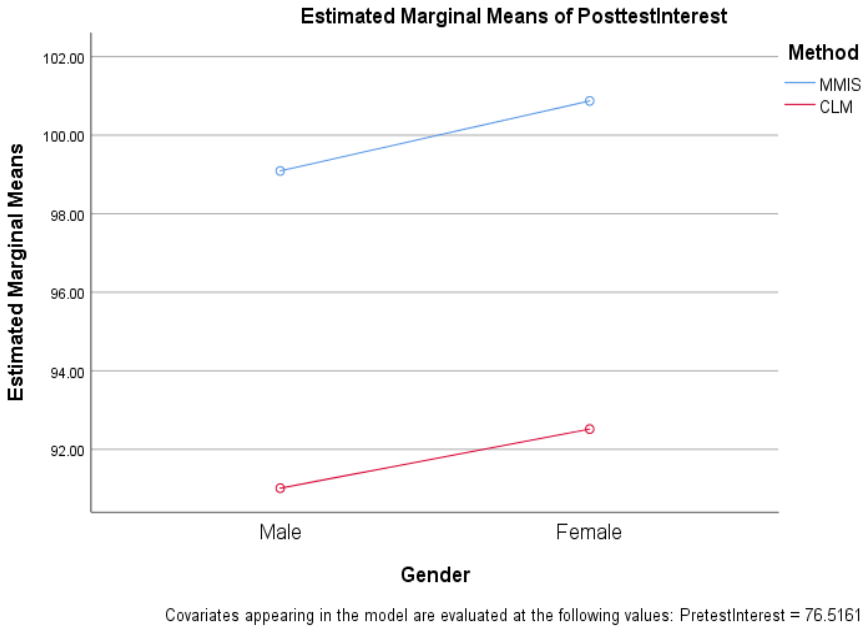

Figure 1: Profile plots of interaction effect of gender and teaching method (MMIS and CLM) on interest of students in Biology.

The profile plots of two teaching methods on male and female students' interest scores are parallel to each other without any intersect. Hence, there is no interaction effect of gender and teaching method on interest of students in Biology. By implication, the effect of the two methods of teaching on the mean interest scores of students in Biology does not depend on their gender. This implies that the treatment affected the mean interest scores of male and female students in Biology in the same way.

DISCUSSION

The finding of the study revealed that the mean interest score of students was significantly higher in biology when taught using MMIS than those taught using CLM. Therefore, the use of MMIS enhances students' interest in Biology than CLM. This is because mind mapping instructional strategy creates a link or connections with the mind and ideas in the classroom which helps in building students' interest in the class. It also promotes greater creativity and memory for all learners by using a major stimulator such as colour; which appeals to aesthetic sensitivities which increase the brain's pleasure in building the mind map, and its interest in returning to, reviewing and using it which was not obtainable in CLM. The finding of the study agrees with that of Babagana et al (2018), Khatimah and Rachman (2018), Okereke and Okigbo (2019) and Wahyu (2019) who revealed, in their respective studies, that mind mapping is an innovative instructional strategy that increases and sustains student's interest in the teaching and learning process.

On gender, the study revealed that there was no significant difference between the mean interest scores of male and female students taught Biology. This is because MMIS gave equal chances to both genders in striving to improve their interest in Biology in the course of the treatment. Hence, MMIS significantly promotes both male and female students' interest in Biology. This finding concurs with that of Aniaku, (2012) and Okereke and Okigbo (2019) who revealed, in their respective studies in biology, that gender had no significant influence on students' interest. The study however disagrees with the finding of Odagboyi (2015), who reported that there was a significant influence of gender and students' interest in biology in favour of the male students while Bawaneh (2019) found that female students have more interest in biology as they prefer it more to their male counterparts.

On interaction effect, the study revealed that there was no significant interaction effect of gender and teaching method on interest of students in Biology. The finding concurs with that of Audu (2018), Nkok (2022), and Nwuba et al (2023b) who reported in their respective studies that there was no significant interaction effect of approach and gender on students' interest.

CONCLUSION

Based on the findings of this study, the study concluded that MMIS is an effective instructional strategy that can be used to foster students' interest in biology, irrespective of gender. Hence, it could be adopted as a gender friendly alternative instructional strategy in the teaching of biology.

RECOMMENDATIONS

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

1. Teachers, through seminars, workshops and conferences, should be trained on how to use MMIS to sustain students' interest in biology.
2. Provision should be made by school administrators and stakeholders for instructional materials that will enable teacher adopt and students to learn using MMIS.
3. Students should be made to construct mind maps during the teaching and learning of biology, this will invariably sustain their interest.

ACKNOWLEDGEMENT

The researchers' immense gratitude goes to the principals, teachers and students of the sampled schools used for the study for their maximum cooperation throughout the period of the research work (field study). In a special way, the researchers also appreciate the validators' of their instrument as well as the different authors whose works were cited in the research work

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