

## ENHANCING ACADEMIC ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN BIOLOGY USING MNEMONIC INTEGRATED INSTRUCTION

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**Abstract:** *Although the use of innovative instructional methods in teaching in the 21<sup>st</sup> century has been recognized to promote the acquisition of the skills needed by individuals to survive in the modern globalized society, these methods however to an extent have failed to achieve their main aim which is geared towards helping students excel in various aspects of examination, as in using these methods alone, students tend to acquire these skills but to an extent not easily recall the simple facts needed to pass most external examinations. In this light, the researcher sought out to find out if the integration of mnemonic instructions into these teaching methods will help students recall facts easily and hence perform better in examinations. To achieve the purpose of the study, two research questions and three null hypotheses tested at 0.05 alpha levels guided the study. The study adopted a quasi-experimental research design, specifically, the pretest posttest non-randomized control group design. The population of the study comprised all the 4,627 SS2 students in the 62 government owned schools in Awka Education Zone. A sample size of 43 students drawn from two intact classes were selected for the study using multi-stage sampling procedure. Biology Achievement Test (BAT) validated by three experts with a reliability co-efficient of 0.89, established using Kuder-Richardson 20, was used for data collection. The data obtained for the study were analyzed using mean and standard*

*deviation in answering the research questions and Analysis of Covariance (ANCOVA) in testing the null hypotheses at 0.05 alpha level. The findings of the study revealed that integrating mnemonics into teaching methods was very effective in enhancing students' achievement in Biology irrespective of gender. Thus, it was recommended among others that biology teachers should integrate mnemonics in their classroom instruction as it makes the classroom lively, entertaining and, when effectively implemented, enhances students' academic achievement.*

**Keywords:** *Mnemonic Integrated Instruction; Academic Achievement; Biology*

## **Introduction**

Biology is one of the science subjects studied in Nigerian secondary schools. Asuzu and Okoli (2019) defined it as a natural science that studies the living world; how it functions, what these functions are, how living things came into existence and their interaction with each other and their environment. It is a natural science concerned with the study of life and living organisms (Nwuba & Osuafor, 2021). Hence, it is a branch of science that studies living things and their interactions with each other and their environment.

Biology, as a subject, is very important in nation building as well as scientific and technological development. Uzoma and Okoli (2019) opined that a sound knowledge of biology is needed in our everyday lives as well as in many fields of study and industries such as medicine, pharmacy, nursing, agriculture, and engineering. On a similar note, Pat-Anyaeji and Okeke (2019) emphasized that the knowledge of biology helps one in understanding the world in its natural processes and with the knowledge obtained create a better environment to live in. Hence, biology, in general, provides the knowledge applied in every sphere of life today ranging from food production, environmental protection, conservation of resources, bioengineering and agriculture, prompting its inclusion in the secondary school curriculum in Nigerian secondary schools.

Considering the above advantages and the subject's nature of little or no mathematical calculations, Akubuilu (2014) opined that the biology has popularity among students and as a result has the highest enrollment by students in external examinations when compared to other science subjects. Notwithstanding its importance and popularity among students, the recorded

performance of students in the subject in external examinations over the years has remained unsatisfactory and inconsistent as seen in the statistic report of WAEC from 2015-2019. In 2015, for aggregate of A<sub>1</sub>-C<sub>6</sub>, a percentage pass of 57.42 was recorded, 61.68% in 2016, 55.57% in 2017, 55.10% in 2018 and 55.63% in 2019 showing that students' performance in the subject over the years has remained slightly above average. Many researchers (Uzoma & Okoli, 2019, Ufommadu & Okoli, 2019; Nwuba & Osuafor, 2021) have attributed this unsatisfactory performance to many factors among which include lack of adequate laboratory facilities and instructional aids, unconducive learning environment, high student-teacher ratio, wide content of secondary school biology curriculum and most importantly, the predominant use of conventional methods of teaching in the classroom.

Conventional methods of teaching refer to approaches to teaching involving the teacher in front of the learner's disseminating information and the learners taking down the information. Ufommadu and Okoli (2019) described them as teacher-centred methods frequently utilized in the classroom that involves less participation on the part of students. These methods although widely recognized and utilized by teachers in the classroom because of their wide range of advantages which include faster coverage of a large content within a short time, development of students' listening, language and secretarial skills as well as their usefulness in teaching a large population according to Paris (2014) have been criticized by many because of their shortcomings in achieving a lesson stated objectives. These shortcomings of conventional methods have driven education stakeholders to search of alternative approaches that may be employed to enhance achievement of students in the classroom, this ushered in the era of innovative teaching methods.

Innovative methods of teaching are activity-based and student-centred pedagogical approaches of learning that puts the learners first and foremost in any teaching and learning process. Nwuba (2021) described them as instructional methods that brings knowledge to the doorstep of learners through actively engaging them in the learning process. Positively, In the recent times, several research reports (Nwuba & Osuafor, 2021; Odukwe, 2018) have shown that through these innovative methods, the 4C STEM (Science, Technology, Mathematics and Engineering) skills of creativity, critical thinking, collaboration, and communication are acquired effectively but a thorough perusal of the WAEC statistic reports of students in biology, as reported above, have shown that the academic achievement of students in the subject in external examinations have still not increased yet to the expectancy of educational stakeholders. In this light, the researcher advocated for the integration of mnemonic instruction into these teaching methods (both conventional and innovational) to see if it which will go a long way in helping

students remember simple biology facts and thus help improve their achievement in external examinations.

Mnemonic integrated instruction emphasizes on learning for long term retention as it is specifically designed to improve memory. Jurowski, Jurowska and Krzeckowska (2015) defined it as a memory-enhancing pedagogical method aimed at improving learning and information recall through the use of mnemonics. Solso (2005) defined mnemonics as devices that help learners learn faster, recall better while keeping learners motivated and the classroom very interesting. Hence in the context of this study, mnemonic integrated instruction can be defined as an instructional strategy that involves the inculcation of memory enhancing devices within the teaching and learning process with the aim of making learning activity-based, fun-filled, and interesting.

Mnemonic devices vary and are of different types that teachers and learners may employ. Thompson (as cited in Amirousefi & Ketabi, 2011) identified five classes of mnemonics namely: Linguistic, Spatial, Visual, Physical response and Verbal methods. Linguistic mnemonics, which include the pegword, keyword and letter methods (acronyms, abbreviations and acrostics), involve associating the new concept to be learnt with familiar words, phrases and/or sentences to help remember the concept. Spatial mnemonics, which include the loci, spatial grouping and finger methods, involve connecting the new concept to a familiar place, pattern or finger to help in memorization of the material. Visual mnemonics make use of pictures or visualizations to create an association to the target concepts (e.g. symbols, pictographs). Physical response methods make use of the body parts or gestures to aid in remembrance, either through movement or physical sensation while the verbal method uses meaning, rhymes, songs and stories in the form of grouping or semantic organization and story-telling or narrative chains to help students remember.

In his study, Koksal (2013) opined that these devices play an important role not only in the course of learning words but also in remembering the learnt words. Similarly, Lerner (2003) noted that the major difficult task in developing mnemonic strategies is the cognitive thinking needed to find a way to relate the new information to the information students already have locked in their long-term memory, but once this cognitive thinking is developed in teachers and students, the mnemonic instruction becomes easily and efficiently utilized because of its following advantages: it is an inexpensive strategy that can be used to teach a large population with learners still actively involved in the lesson, can be used to cover a large content in a short time, no specific level of teaching experience is required to learn or use the strategy and, there is no additional costs for purchase of its material or technology. In light of its advantages, this research work hinged on finding out if integrated

mnemonic instruction will help boost students' academic achievement in biology.

Academic achievement is described as the gain in one's knowledge as a result of taking part in a learning activity or programme. Uwaleke and Offiah (2013) described it as a student's performance on a standard of measurement such as performance test, skill test or analytical thinking test. This simply implies that academic achievement is a result-oriented output that explains the extent of one's performance in a desired task. In the context of this study, academic achievement therefore refers to one's performance in a test after exposure to an educational programme over a period of time irrespective of gender.

Gender is a social construct given to male and female. Ezeh (2013) described it as expectations held about the characteristics, attitudes and likely behaviour of both men and women (masculinity and femininity) in the society. Hence, gender is simply an attribute ascribed to male and female based on biological characteristics. Issues on gender influence on students' achievement in biology for over the years has remain inconsistent and inconclusive. For instance, while many researchers (Nwuba & Osuafor, 2021; Uzoma & Okoli, 2019) have reported in their various studies in biology that gender has no significant influence on students' achievement, some (Pat-Anyaeji & Okeke, 2019; Egwu & Okigbo, 2021) reported that male students achieve higher than female students in biology.

This inconclusive results on gender calls for further investigation to find out if gender influences students' academic achievement in biology or not. Therefore, in this study, gender differences in academic achievement among secondary school students' taught biology using mnemonic integrated instruction was also investigated. It is against this backdrop that the researcher deemed it necessary to find out if the use of MIS can enhance secondary school students' academic achievement in biology in Awka Education Zone.

### **Statement of the Problem**

The role of biology in national development and wealth creation cannot be overemphasized, this is probably why most secondary schools in Nigeria offer it as a pre-vocational subject for its science and art students, aimed at preparing them for life in a competitive global economy after school. Despite these importance, students' performance in the subject in both internal and external examinations over the years have remained unsatisfactory. Many researchers till today have attributed this unsatisfactory performance of students in biology to several factors of which most emphasis has been placed on the conventional teaching methods that dominates the classrooms, which makes the teaching and learning of the subject uninteresting, and students' achievement in the subject unsatisfactory.

To curtail this trend, several efforts have been made in the past and present by the government at all levels of Education through the provision of resources as well as organization of conferences, workshops, and seminars to educate teachers on innovative methods and strategies to improve student's achievement in the subject, but still little/ or inconsistent improvement have been recorded over the years. In this light, the research sought to find out if integrating mnemonic instruction into teaching strategies will help improve students' performance in the subject.

### **Research Questions**

The following research questions guided the study

1. What is the difference in the pretest posttest mean achievement scores of students taught biology using mnemonic integrated instruction and those taught using conventional lecture method?
2. What is the difference in the pretest posttest mean achievement scores of male and female students taught biology using mnemonic integrated instruction?

### **Hypotheses**

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

1. No significant difference exists between the mean achievement scores of students taught Biology using mnemonic integrated instruction and that of those taught using conventional lecture method.
2. No significant difference exists between the mean achievement scores of male and female students taught Biology with mnemonic integrated instruction.
3. There is no interaction effect of gender and teaching methods on students' academic achievement in biology

### **Method**

The research adopted a quasi-experimental research design. Specifically, the pretest posttest non-randomized control group research design. The population of the study comprised all the 4,627 SS2 students in the 62government owned secondary schools in Awka Education Zone, Anambra State. 43 SS2 biology students in two intact classes sampled from two secondary schools in the zone using multi-stage sampling procedure constituted the sample of the study. A Biology Achievement Test (BAT) developed by the researchers from compiled SSCE biology past questions was used for data collection. The 25-item multiple choice objective test question with four response options lettered A-D was developed using a well-structured table of specifications to ensure content coverage. The instrument (BAT) was validated by three experts (two from the Department of Science Education and one from Department of Educational foundations, Measurement and

Evaluation) all from Faculty of Education, Nnamdi Azikiwe University, Awka, Anambra State. To ascertain the reliability of the instrument, the BAT was administered to a class of 40 students in Aguata Education zone, who are not part of the study, and using Kuder-Richardson 20 (KR-20) formula, a reliability coefficient of 0.89 was obtained showing that the instrument was highly reliable.

The experiment commenced with the two intact classes sampled from two different schools in the zone being assigned to control and experimental group using a toss of a coin. After this, the BAT was administered to both groups which served as the pretest score. After the pre-testing, the actual experiment commenced with the briefing of the biology teachers who were used for the study. The teacher for the experimental group was briefed on MIS, its types and how to properly integrate the instruction when teaching in the classroom while the teacher for the control group was asked to teach as usual with lesson plans developed by the researcher. After the briefing, the teaching exercise for the two groups commenced for a period of 4 weeks. After the period of teaching, a posttest was administered to both groups, which served as the post test score. The data obtained from the two tests were analyzed using mean and standard deviation in answering the research questions and ANCOVA in testing the null hypotheses at 0.05 level of significance.

## Results

**Research Question One:** What is the difference in the pretest posttest mean achievement scores of students taught Biology using mnemonic integrated instruction and those taught using only conventional lecture method?

Table 1: Mean Achievement and Standard Deviation Scores of students taught biology using MIS and those taught with CLM

Method	N	Pretest		Posttest		Gain in mean
		Mean	Std. Dev.	Mean	Std. Dev.	
MIS	21	12.55	0.68	19.18	0.76	6.63
CLM	22	11.48	0.76	13.86	0.88	2.38
Mean Difference		1.07		5.32		4.25

Table 1 shows the various means and standard deviation scores on achievement of students taught Biology using MIS (experimental group) and those taught using CLM (control group). From table 1 above, Experimental group had the mean achievement scores of 12.55 and 19.18 in the pretest and posttest respectively while their counterparts taught with CLM had achievement mean scores of 11.48 in the pretest and 13.86 in the posttest. The mean difference of the gains in mean for MIS and CLM, revealed that students

in the experimental group achieved higher than those in the control group with a mean difference of 4.25. The result indicated that integrating the various types of mnemonics in the lesson when teaching biology highly increased students' academic achievement more than CLM.

**Research Question two:** What is the difference in the mean achievement scores of male and female students taught Biology using mnemonic integrated instruction?

Table 2: Mean Achievement and Standard Deviation Scores of male and female students taught biology using MIS

Gender	N	Pretest		Posttest		Gain in mean
		Mean	Std. Dev.	Mean	Std. Dev.	
Male	8	11.87	0.93	19.50	1.12	7.63
Female	14	12.92	0.93	19.00	1.04	6.08
Mean Difference	22	1.05		0.50		1.55

Table 2 above shows that for the experimental group, the male students had a mean achievement scores of 11.87 and 19.50 in the pretest and posttest respectively while their female counterparts had 12.92 in the pretest and 19.00 in the posttest. The mean difference in the gains in mean for the male and female students taught biology using mnemonics integrated instruction is 1.55. From the gains in means, it can be deduced that male students achieved higher than the female students when both are taught selected concepts in biology using mnemonic integrated instruction.

**Hypothesis 1:** There is no significant difference between the mean achievement scores of students taught biology using MIS and that of those taught with CLM.

Analysis of hypothesis one is presented in table 3.

**Table 3: ANCOVA Test of Significant Difference between the Mean Achievement Scores of Students Taught Biology Using MIS and those Taught Using CLM**

Dependent Variable: pretest						
Source	Type III Squares	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	304.936 <sup>a</sup>		4	76.234	17.660	.000
Intercept	4.112		1	4.112	.953	.335
Posttest	238.985		1	238.985	55.361	.000



METHOD	49.205	1	49.205	11.398	.002
METHOD * gender	31.634	1	31.634	7.328	.010
Error	164.041	38	4.317		
Total	6685.000	43			
Corrected Total	468.977	42			

a. R Squared = .650 (Adjusted R Squared = .613)

The result of the two-way ANCOVA from table 3 above shows that the F-value is 11.98 and P-value is .002. Since the P-value is less than 0.05 level of significance at df 1 and 38, the null hypothesis is rejected. This shows that there is a significant difference between the mean achievement scores of students taught biology with MIS (experimental group) and that of those taught with CLM (control group) in favour of those in the experimental group. This indicates that integrating mnemonic devices in teaching biology concepts is a significant factor in academic achievement of students in the experimental group.

**Hypothesis 2:** No significant difference exists between the mean achievement scores of male and female students taught biology using MIS.

Analysis of hypothesis two is presented in table 4

**Table 4: ANCOVA Test of Significant Difference between the Mean Achievement Scores of Male and Female Students Taught Biology Using MIS**

Dependent Variable: pretest						
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	
Corrected Model	135.435 <sup>a</sup>	2	67.718	16.491	.000	
Intercept	.690	1	.690	.168	.686	
Posttest	129.785	1	129.785	31.606	.000	
Gender	9.953	1	9.953	2.424	.136	
Error	78.019	19	4.106			
Total	3676.000	22				
Corrected Total	213.455	21				

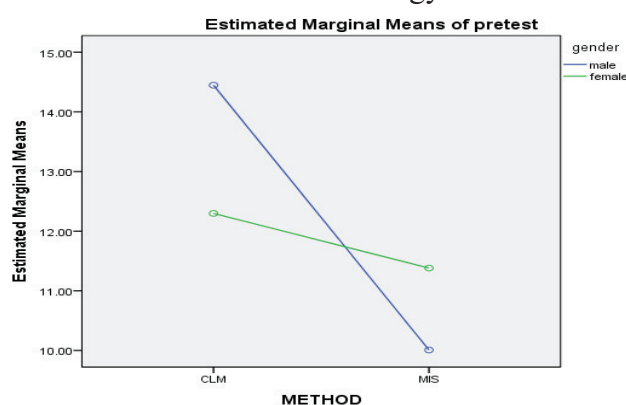
a. R Squared = .634 (Adjusted R Squared = .596)

The result of the two-way ANCOVA from table 4 above shows that the F-value is 2.424 and P-value is 0.136. Since the P-value is greater than 0.05 level of significance at df 1 and 19, the null hypothesis is not rejected. This shows that there is no significant difference in the mean achievement

scores of male and female students taught biology using inquiry approach with mnemonics. Hence, indicating that the use of MIS in teaching students is not gender biased.

**Hypothesis 4:** There is no interaction effect of gender and teaching methods on students' academic achievement in biology

The result of the two-way ANCOVA from table 3 above shows that F-value is 7.328 and P-value is 0.010. Since the P-value is less than 0.05 alpha levels at df 1 and 38, the null hypothesis is rejected. Showing that there is interaction effect of gender and methods of teaching on the academic achievement of students in biology.



Covariates appearing in the model are evaluated at the following values: posttest = 16.5814

**Figure 1:** Profile Plot of Interaction Effect of Teaching Methods and Gender on the Achievement of Students in Biology

### Discussion of findings

The finding of the study showed that the students taught biology with MIS gained in achievement more than the students taught using Conventional Lecture Method (CLM). The finding of this study lends credence to the findings of Anandhi and Raja (2015), Akinsola and Odeyemi (2014), Nja, Idiege and Obi (2017) and Khoo (2012) who reported in their studies in basic science, mathematics, chemistry, and economics respectively that students taught science related subjects using mnemonics achieved higher than their counterparts in the control group.

On the influence of gender, the study revealed that the males achieved higher than the females. However, on testing the null hypothesis in table 4, it was revealed that the difference is not significant. The finding of this study supports the findings of Akinsola and Odeyemi (2014), Chikwendu (2018) who revealed in their studies that gender has no influence on students' academic achievement.

On interaction effect of teaching methods and gender on achievement of students in biology, the finding of the study revealed that there was interaction effect of teaching methods and gender on students' achievement in

biology. From the findings, it can be deduced that the use of integration of mnemonics in the teaching and learning process produced more positive effect on students learning achievement as they are gender friendly devices that encourages retention. Hence, students will achieve better if teachers incorporate mnemonics in teaching biology at senior secondary schools in Nigeria.

### **Conclusion**

Based on the findings, the study concluded that MIS positively improved students' achievement in biology irrespective of gender more than CLM.

### **Recommendations**

In the light of the findings of the study, the following recommendations were made:

1. Biology teachers in secondary schools should integrate MIS when teaching to improve students' academic achievement in biology.
2. Seminars, symposia, workshops, and conferences should be organized for biology teachers by the government, education stakeholders and professional bodies (STAN) to familiarize teachers with mnemonics and its types as well as how to integrate it in the teaching and learning process.

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