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Effect of Explicit Teaching, Concept Mapping and Mind Mappings Instructional Approaches on Students' Motivation, Achievement, and Retention in Secondary School Biology in Benue State, Nigeria

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Abstract
This study investigated the effect of explicit teaching, concept and mind mappings on students' motivation, achievement and knowledge retention in biology at the secondary school level in Benue State. Three null hypotheses tested at 0.05 level of significance were formulated to guide this study The population of the study consisted of 20,699 Senior Secondary School II students who studied biology in the 2024/2025 academic session in all the 394 Senior Secondary Schools in Benue State The design adopted for this study was non-randomized pre-test - post-test quasi-experimental design. A sample of 315 students in nine intact classes were purposively from nine secondary schools; three each from the three education zones in Benue State. The three classes in each zone were purposively assigned to the three experimental groups; explicit teaching, concept mapping and mind mapping groups respectively. The instruments for data collection were Biology Learning Motivation Questionnaire (BLMQ), Biology Achievement Test (BAT) and Biology Retention Test (BRT). Data analysis was carried out using mean, standard deviation, and Welch Analysis of Variance. Results from analysis of data showed that there was no statistically significant difference in the mean motivation scores of the three groups of students, $F(2, 312) = 0.89$, $p=0.41$. On students' academic achievement, the study established a statistically significant difference in the mean achievement scores of the groups, $F(2,312) = 58.321$, $p=0.01$. The concept mapping group was shown to be superior to the explicit teaching and mind mapping groups in enhancing academic achievement. Similarly, a significant difference was observed in the mean retention scores of the three groups $F(2,312) = 7.79$, $p=0.001$. Here too the concept mapping group outperformed the explicit teaching and mind mapping group. In both achievement and retention, the mean scores of mind mapping were significantly higher than the explicit teaching group. Based on these results, this study recommended the frequent use of knowledge maps especially concept mapping instructional approach in teaching biology at the secondary school level in order to enhance, motivation, achievement, and retention of knowledge in biology

Key Words: *Explicit teaching, Concept map, Mind map, Motivation Achievement Retention.*

Introduction

Biology is a scientific discipline that studies the processes of living organisms including humans. The innumerable contributions of biology in the life of man are glaringly seen in the roles of biological science disciplines such as biomedical, agricultural and environmental sciences. In addition, secondary school biology is a very strong basic requirement for the study of biological sciences and other related discipline at higher educational level. Considering the critical position of biology, it is vital that the learning of biology especially at the secondary education level should not be toyed with,. Therefore, the effective teaching of biology for enhancement of students' motivation to learn, promoting greater academic achievement, and knowledge retention in biology are very fundamental to the attainment of the aims and objectives as well the remote goals of learning the subject..

One salient unfortunate situation plaguing science education generally including biology at the secondary school level in Nigeria, is students' poor quality of learning culminating in underachievement. This is evidenced by students' performance in biology and other science subjects at the tertiary level of Nigeria educational system, particularly at the university level where students' performance is at variance with the excellent results obtained by students in Senior Secondary School Examination (SSCE) conducted by West African Examination Council (WAEC), National Examination Council (NECO) and National Board for Technical Education (NABTE). Academic Staff Union of Universities in Nigeria ([ASUU], 2025) decried this situation, noting that students with outstanding grades in SSCE, perform poorly in semester examinations thereby, betraying their A1's and B3's results used in gaining admission. This situation according to ASUU applies to all department in universities. The excellent grades of these students are no doubt proceeds of examination malpractice that is traceable to several factors. These include poor quality teaching principally as a result of science teacher's use of ineffective teaching approaches, specifically science teacher predominant use of lecture method demonstrated to be very ineffective in meaningful learning, motivation and long-term retention of what is taught (Akinwumi et...al. (2024; Achuonye, 2015; and Kola & Langenhoven, 2015) It is therefore, strongly essential that instructional approaches used by teachers cater for students' motivation, achievement, and foster a long-lasting retention of knowledge in biology. There are several instructional approaches that educational literature claim as having potentials for fostering motivation to learn, enhance achievement, and retention of knowledge. However, it is important of note that not all of such instructional approaches fit into the Nigeria classroom instructional setting,. Thus, it very significant to find the most effective instructional approaches that can adequately cater for the learning needs of Nigeria secondary school educational system, bearing in mind our classroom peculiarities. Amongst these approaches are; explicit teaching method and learning maps that include amongst other concept, and mind mappings.

Explicit teaching a direct instructional method, that is a teacher-led teaching method that involves the teacher giving clear, guided instructions to students from the front of the classroom. (Walsh, 2021). The method involves the teacher directing students on what to do and how to do it instead of having students discover knowledge themselves. Students taught by this approach, make greater learning gains than those taught using other direct instructional approaches (NSW Department of Education, 2024). The learning maps according to Knight cited in West (2020) are graphic organizers that keep students focused on what is important, offer a zoomed-out view

of the unit, show the relationship between components of a unit and functions as well as serving as review guides and study tools.

It is against this backdrop that this study comparatively investigated the effect of explicit teaching, concept and mind mappings instructional on students' motivation to learn, achievement and knowledge retention in Biology at the secondary school level. In addition, there are paucity of studies carried out with such a scope in Benue State

Statement of Problem

One overtly observed unfortunate feature associated with secondary school students of science admitted into Nigeria tertiary institutions is the negative correlation between their SSCE grades in WAEC, NECO or NABTE and performances in semester as observed by ASUU (2025). Science students' performance in semester examinations let down their A1's and B3's results used in gaining admission. The students' excellent grades are without mincing words product of examination malpractice orchestrated by several factors including poor quality teaching that results from science teacher's use of ineffective pedagogy predominantly. The most obvious solution in this regard lies strongly in finding, and using potent pedagogical practices that perfectly suits with ease the Nigeria classroom system, and would positively impact on students' motivation to learn meaningfully, enhance their achievement, and promote greater retention of knowledge in biology. It is on this premise that this study was conceived ; to comparatively examine the impact of explicit teaching method, concept and mind mappings on motivation, achievement, and retention of knowledge in biology at the secondary school level, coupled with the fact that research with such a scope are rare in Benue State.

Research Hypothesis

1. There is no statistically significant difference in the mean motivation scores of explicit teaching, concept mapping, and mind mapping students in Biology.
2. There is no statistically significant difference in the mean achievement scores of explicit teaching, concept mapping, and mind mapping students in Biology.
3. There is no statistically significant difference in the mean knowledge retention scores of explicit teaching, concept mapping, mind mapping students in Biology

Literature Review

The general intent of an organized biology classroom teaching of activity is for students to be motivated to meaningfully learn, enhance their achievement and retain what is learned in their long-term memory store. These learning outcomes are largely dependent on the biology teacher's choice of the most potent instructional approaches to use

Explicit Teaching Method

This is a highly teacher-centerd instructional method described as a purposeful way of teaching students, where instruction is systematic, direct, engaging and success oriented, and has been shown to promote achievement for all students. The method is called explicit because it is unambiguous, and direct approach to teaching embracing both instructional design, and delivery procedures thus, it is one of the best tools available to teachers (Archer & Hughes, 2024).

Impact of Explicit Teaching Method on Students' Motivation, Achievement and Retention of knowledge

Explicit teaching method is one of the several instructional methods that fall within the direct instructional strategy. According to Zaferis (2022) explicit teaching is a highly teacher-centred method that involves showing learners what to do and how to do it leaving very little for the students to construct themselves. Explicit teaching is reported to be associated with positive learning benefits. Australian Education Research Organization ([AERC] 2024) identified some of the many benefits of explicit teaching method as:

i. Explicit teaching breaks down and fully explains content thereby aiding students transfer information to memory,
ii. By organizing and sequencing content around specific objectives, explicit teaching deepens students understanding.

In addition, Zaferis (2022) outlined some important learning gains of explicit teaching as:

i. It makes higher-order thinking, inquiry-based, and other forms of student-directed learning more accessible.
ii. It engages students, teaches them the process of learning, and helps them build decision-making, and social skills..
iii. For students who struggle with working memory, it reduces the load on working memory.
iv. Reduces the cognitive load the students face in the classroom, making information processing much easier.

Empirically, Hasan, khurram and Iqbal (2023) established that teaching reading explicitly ensured positive impact on students' motivation to read. Similarly, Caraan (2023) found that explicit teaching method significantly facilitated improvement in mathematics achievement, and motivation in the subject. Sundho and Ali (2023) found that explicit teaching was more effective compared to lecture method in enhancing achievement in mathematics among primary school pupils. Oguejiofor (2020) established that explicit teaching improved the achievement, and attitude of students towards basic science, and had no significant effect on gender achievement, and attitude.

Concept Mapping

A concept map is a diagram or graphical tool that visually represents relationships between concepts and ideas. According Lucid (2019), concept maps depict ideas as boxes or circles (also called nodes), which are structured hierarchically and connected with lines or arrows (also called arcs). These lines are labeled with linking words and phrases to help explain the connections between concepts.

Impact of Concept Mapping on Students' Motivation, Achievement and Retention of knowledge.

Concept maps have been identified with several learning benefits when appropriately used in the classroom. These among others include; expedites understanding with its visual organization, assist students see relationships between ideas, concepts, or activities, helps memory recall, boosts brainstorming and high-level thinking skills, fosters discovery of new concepts and their connections, provides clear communication of complex ideas, promotes collaborative learning and stimulate creativity (Centre for Teaching and Learning, 2019; Lucid, 2019 &WETA, 2019). The impact of concept maps on students' motivation achievement, and knowledge retention have been reported by several studies. Almulla and Alamri (2021) found that concept mapping

increased students' understanding and improved motivation which helped to improve their academic achievement. In the same vein, Amisad (2019) reported that concept mapping approach to instruction was an effective means for improving students' attitude, motivation, and sense of self-efficacy in educational technology. In respect of academic achievement, and retention, Arokoyu and Obunwo (2014) and Agaba (2013) established that concept mapping group had significantly higher scores on achievement and knowledge retention compared to the traditional method group

Mind Mapping

A mind mapping is a graphical way to represent ideas and concepts. It is a visual thinking tool that helps structuring information, helping to better analyze, comprehend, synthesize, recall and generate new ideas (Litemind, 2019). By using a combination of words and pictures and structured in a manner that closely resembles how the brain functions, it engages the brain in a richer way, helping in all cognitive functions (Pinola, 2013).

Impact of Mind Mapping on Students' Motivation, Achievement and Retention of knowledge.

Empirically, the influence of mind maps on students' motivation in learning, academic achievement and knowledge retention has been reported. Sari, Sumarmi,, Utomo and Ridhiwan (2021) found that mind mapping in comparison to inquiry method greatly increased the students ability to think critically, and their motivation to learn. Comparative studies on the effect of mind mapping and concept mapping showed that the former had significantly higher scores than the latter (Shaimaa, Ahmed & Adel; 2018). Similarly, Marashi and Kangani (2018) and Tarkashvand (2015) indicated a statistically significant difference between the mind mapping group that gained a higher mean in both posttests outperforming the concept map group. Similarly learners in the mind mapping group benefited significantly more than those in the concept mapping group in terms of improving their achievement (Zahra & Tarkashvand, 2015; Marashi & Kangani, 2018). In the same vein, Marashi and Kangani (2018) and Tarkashvand (2015) indicated a statistically significant difference between the mind map groups that gained a higher mean in both posttests outperforming the concept map group. Mahasneh (2017) and Batdi (2015) established that mind mapping has a positive effect on academic achievement, attitude and retention compared to the traditional method.

Methodology

Design of the Study

The design to be employed in this study will the non-randomized group pre-test - post-test quasi-experimental design..

Population of the Study

The population of this study will consist of all the 20,699 Senior Secondary School II students who studied Biology in the 2024/2025 academic session in all the 394 Senior Secondary Schools in Benue State (Benue State Government, 2023).

Sample and Sampling Technique

This study employed a sample of 315 students taken from nine intact classes with a size of 35 students in three secondary schools in the three Education Zones in Benue State. The purposive

sampling technique employed in selecting the schools, and assigning classes to the three experimental groups.

Instruments for Data Collection

Three instruments used for collecting data in this study were two versions of 20-item four point Likert-type scale questionnaire; Biology Learning Motivation Questionnaire (BLMQ) used for pretest and posttest. Two versions Biology Achievement Test (BAT) consisting of 20 Multiple Choice Test question drawn from WAEC, and NECO past SSCE biology objective test questions. The version were for pretest and posttest. Biology Retention Test (BRT). BAT and BRT were on Mammalian Nervous System. A table of specification was used to determine the number of items in the different cognitive ability levels of BAT and BRT

Validation of Instrument

Biology Learning Motivation Questionnaire (BLMQ), and Biology Achievement Tests (BAT).and Biology Retention Test (BRT) were validated by three experts, a test and measurement expert, a biology educator, and a biology teacher with more than five years teaching experience. The validators ascertained the face and content validity of the instruments.

Reliability of the Instrument

Reliability of the Biology Learning Motivation Questionnaire (BLMQ) was determined using SPSS reliability by Cronbach's alpha the reliability coefficient to be 0.83 while the reliability of Biology Achievement Test (BAT) was determined using Test-Retest reliability, and was found to be 0.8.

Method of Data Collection

This study employed nine professionally trained graduate Biology teachers with a minimum of five years on the job experience as research assistants who taught the three groups of students and administered the pretest, posttest and retention test. The topic of the lesson was Composition of Mammalian Nervous System using Power-point only. The instructional maps used are shown in Figures 1 concept map, and Figure 2.(mind map).

The pre-tests using one version of BLMQ and BAT were administered prior to treatment that was then followed pretesting. Post-testing was carried out using the second versions of BLMQ and BAT immediately after treatment periods elapsed. After one week from the date of post-testing, BRT will be administered to the three groups in order to ascertain the retention power of the three instructional approaches

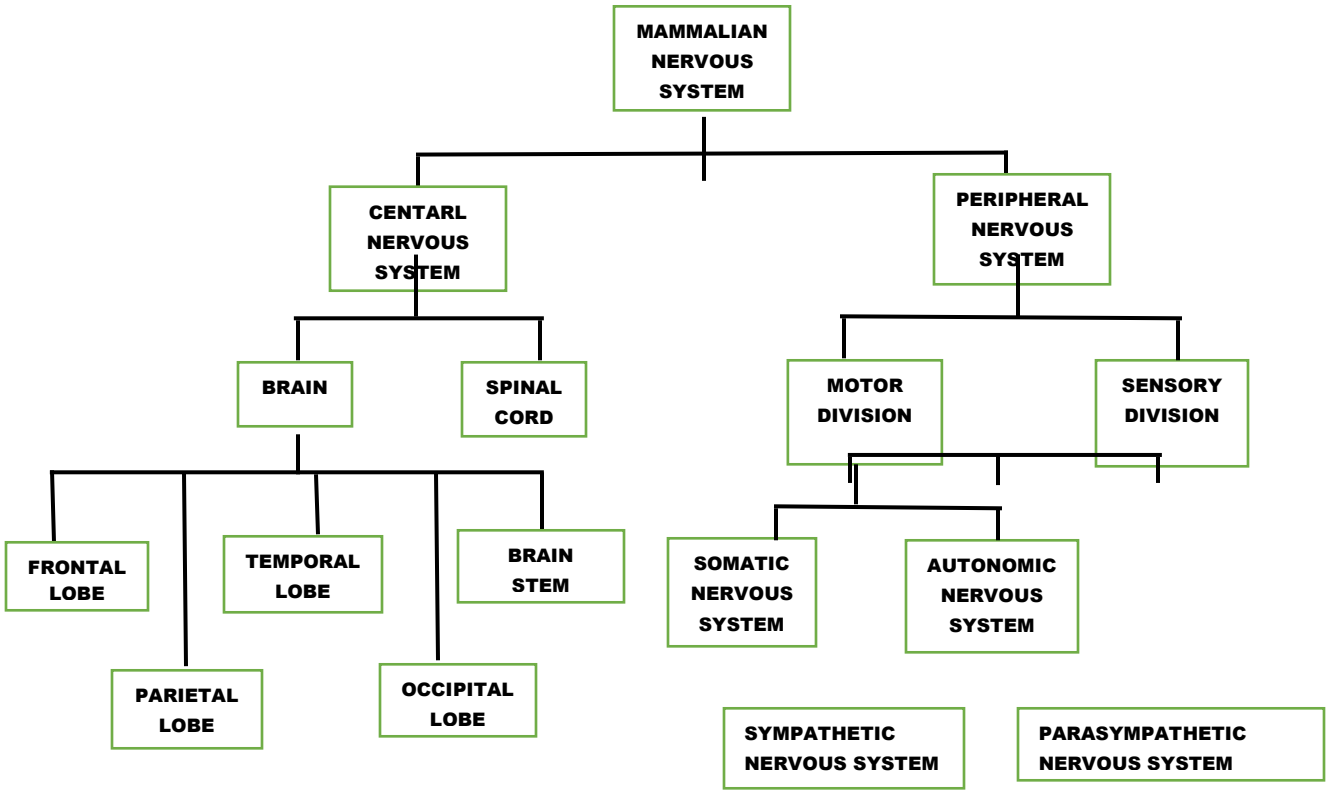

Figure 1; Concept map of the Composition Mammalian Nervous System

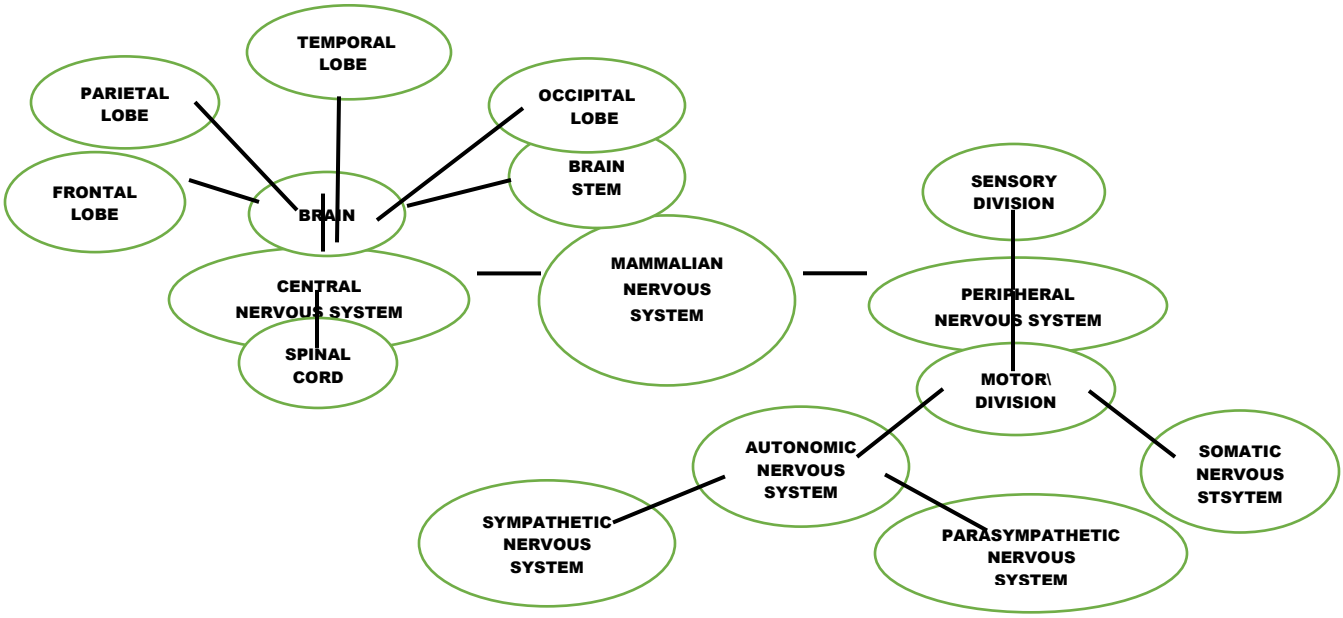

Figure 2 Mind Map of the Composition of Mammalian Nervous System

Data Analysis

Data in this study consisted of pretest and posttest motivation scores generated using Biology Learning Motivation Questionnaire (BLMQ), pretest and posttest achievement scores generated using Biology Achievement Test (BAT), and scores of retention test obtained using Biology Retention Test (BRT). Analysis of these data were carried out using descriptive, mean, standard deviation and inferential statistics; Welch Analysis of variance (ANOVA) that was used to test the null hypotheses of the study.,

Results

Analysis of pretest and posttest data collected on the effect of explicit teaching, concept and mind mapping on student motivation, achievement and retention in biology is presented in Tables 1, 2 and 3.

TABLE 1: PRETEST AND POSTTEST MEAN MOTIVATION SCORES OF EXPLICIT TEACHINGS, CONCEPT MAPPING AND MIND MAPPING GROUPS IN BIOLOGY

Groups	N	Pretest Mean	Posttest Mean	Mean Gain Score
Explicit Teaching	105	2.58 (SD=0.25)	2.63 (SD= 0.15)	0.05
Concept Mapping	105	2.59 (SD= 0.09)	2.66 (SD= 0.11)	0.07
Mind mapping	105	2.45 (SD=0.08)	2.66 (SD=0.15)	0.21

TABLE 2: PRETEST AND POSTTEST MEAN ACHIEVEMENT SCORES OF EXPLICIT TEACHINGS, CONCEPT MAPPING AND MIND MAPPING GROUPS IN BIOLOGY

Groups	N	Pretest Mean	Posttest Mean	Mean Gain Score
Explicit Teaching	105	5.02 (SD=1.70)	7.20 (SD=2.80)	2.18
Concept Mapping	105	4.80(SD=1.45)	11.11 (SD=2.50)	6.31
Mind mapping	105	4.77(SD=2.17)	9.25(SD=2.60)	4.48

TABLE 3: PRETEST AND POSTTEST MEAN RETENTION SCORES OF EXPLICIT TEACHING, CONCEPT MAPPING AND MIND MAPPING GROUPS IN BIOLOGY

Groups	N	Retention Mean	Std. Deviation
Explicit Teaching	105	7.65	3.16
Concept Mapping	105	8.60	2.95
Mind mapping	105	7.00	2.53

Hypothesis Testing

Levene's Test for Homogeneity of Variance

Levene's test was conducted to ascertain the homogeneity of the variance of the groups. Table 4 presents result of the homogeneity test

TABLE 4: RESULT OF LEVENE'S TEST OF HOMOGENEITY OF VARIANCE OF THREE GROUPS

Levene Statistic	*df1*	*df2*	*Sig.*
3.649	2	312	.027

Significance level is 0.05

Result of the Levene's test statistic revealed that at $p<0.05$ the variances of the three groups were not equal; $F(2,312) = 3.65$, $p=0.03$. Hence, the study used Welch ANOVA to compare the effect of the three instructional; approaches groups of students on the motivation, achievement and retention in Biology

Null Hypothesis 1: There is no statistically significant difference in the mean motivation scores of explicit teaching method, concept mapping and mind mapping students in biology.
Welch ANOVA test was conducted to determine if there were statistically significance difference between the mean motivation scores of students of explicit teaching group (M = 2.63, SD =0.15), concept mapping group,(M=2.66 SD=0.11) and mind mapping group, (M=2.66, SD=0.15).Tables 5 and 6 shows the results of Welch ANOVA test.

TABLE 5: Welch ANOVA RESULT OF DIFFERENCE IN THE MEAN MOTIVATION SCORES OF THE THREE GROUPS OF STUDENTS IN BIOLOGY

Group	Sum of Squares	*df*	Mean Squares	*F*	*Sig.*
Between Group	0 .03	2	0.02	0 .89	0.41
Within Group	6.39	312	0.02		
Total	6.43	314			

TABLE 6: ROBUST TEST OF EQUALITY OF MEAN MOTIVATION SCORES OF EXPLICIT TEACHING, CONCEPT MAPPIN AND MIND MAPPING IN BIOLOGY

Test Statistic	Statistic	*df1*	*df2*	*Sig*
Welch	0.84	2	202.72	0.43

a. Asymptotically F distributed.

The result showed that there was no statistically significant difference in the mean motivation scores of the groups; $F(2, 312) = 0.89$, , $p=0.41$.

Null Hypothesis 2: There is no statistically significant difference in the mean achievement scores of explicit teaching, concept mapping, and , mind mapping students in Biology.
Welch ANOVA test was conducted to ascertain whether statistically significance differences existed in the mean achievement scores of explicit teaching group (M =7.20 , SD =0.27), concept mapping group,(M=11.11, SD=0.24) and mind mapping group, (M=9.26, SD=0.25).Tables 7 and 8 show the results of Welch ANOVA test.

TABLE 7: Welch ANOVA RESULT OF DIFFERENCE IN THE MEAN ACHIEVEMENT SCORES OF THE THREE GROUPS OF STUDENTS IN BIOLOGY

Group	Sum of Squares	*df*	Mean Squares	*F*	*Sig.*
Between Group	805.09	2	402.54	58.31	0.01
Within Group	2153.49	312	6.90		
Total	2958.57	314			

TABLE 8: ROBUST TEST OF EQUALITY OF MEAN ACHIEVEMENT SCORES OF EXPLICIT TEACHING, CONCEPT AND MIND MAPPING IN BIOLOGY

Test Statistic	Statistic[a]	*df1*	*df2*	*Sig*
Welch	57.14	2	207.53	0.01

a. Asymptotically F distributed.

Result of the Welch ANOVA test revealed that there were statistically significant differences in the mean achievement scores at $p<0.05$ level for the groups of students F (2,312) = 58.32, p=0.01.

Results of post hoc test of the differences in the means of the different groups are shown in Table 9.

TABLE 9; RESULT OF POST HOC TEST OF DIFFERENCES IN THE MEAN ACHIEVEMENT SCORES OF EXPLICIT TEACHING, CONCEPT MAPPING AND MIND MAPPING GROUPS IN BIOLOGY

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Explicit Teaching	Concept Mapping	-3.91*	0 .36	0 .01
	Mind mapping	-2.06*	0. 36	0 .01
Concept Mapping	Explicit teaching	3.91*	0 .36	0 .01
	Mind mapping	1.86*	0 .36	0 .01
Mind Mapping	Explicit teaching	2.06*	0 .36	0 .01
	Concept Mapping	-1.86*	0. 36	0 .01

* The mean difference is significant at the 0.05 level

The results of the first paired comparison revealed that the mean achievement score of explicit teaching group (M=7.20, SD=0.27) was significantly lower than the mean achievement scores of concept mapping group (M=11.11, SD=0.24) and mind mapping group (M=9.26, SD=0.26) at p<0.05. In the second paired comparison, the mean achievement score of concept mapping group (M=11.11, SD=0.24) was significantly higher level than the means of both the explicit teaching students ((M =7.20 , SD =0.27) and mind mapping group (M=9.26, SD=0.26) at p< 0.05 The third paired comparison revealed that the mean achievement score of mind mapping group (M=9.26, SD=0.26) was significantly higher than the explicit teaching group (M=7.20, SD=0.27) but significantly lower than the concept mapping group(M=11.11, SD=0.24), at p<0.05 level

Null Hypothesis 3: There is no statistically significant difference in the mean retention scores of explicit teaching, concept mapping, and mind mapping students in Biology.
Welch ANOVA test was conducted to ascertain if there were statistically significance differences in the mean achievement scores of explicit teaching students, (M =7.34 , SD = 3.68), concept mapping group, (M=8.60, SD=2.95) and mind mapping group, (M=7.00, SD=2.53).Tables 10 and 11 show the results of Welch ANOVA test.

TABLE 10: Welch ANOVA RESULT OF DIFFERENCE IN THE MEAN RETENTION SCORES OF THE THREE GROUPS OF STUDENTS IN BIOLOGY

Group	Sum of Squares	*df*	Mean Squares	*F*	*Sig.*
Between Group	149.03	2	74.51	7.79	.001
Within Group	2982.35	312	9.56		
Total	3131.89	314			

Result of the ANOVA test revealed that there was a statistically significant difference in mean achievement scores for the groups of students $F(2,312) = 7.79$, $p=0.01$.

TABLE 11: ROBUST TEST OF EQUALITY OF MEAN RETENTION SCORES OF EXPLICIT TEACHING, CONCEPT AND MIND MAPPING IN BIOLOGY

Test Statistic	Statistic	*df1*	*df2*	*Sig*
Welch	9.195	2	203.63	0.01

a. Asymptotically F distributed.

Results of post hoc test of the differences in the means of the different groups are shown in Table 12

TABLE 12; RESULT OF POST HOC TEST OF DIFFERENCES IN THE MEAN RETENTION SCORES OF EXPLICIT TEACHING, CONCEPT AND MIND MAPPING GROUPS IN BIOLOGY

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.
Explicit Teaching	Concept Mapping	-1.26*	0.42	0 .01
	Mind mapping	0.34	0 42	0.70
Concept Mapping	Explicit teaching	1.26*	0.42	0.01
	Mind mapping	1.60*	0.42 .	0.01
Mind Mapping	Explicit teaching	-0.34	0.42	0.70
	Concept Mapping	-1.60*	0 .42	0.01

* The mean difference is significant at the 0.05 level

The results of the first paired comparison revealed that the mean retention score of explicit teaching group (M=7.34, SD=3.68) was significantly lower than the mean retention score of concept mapping group (M=8.60, SD=0.24), *p*=0.01. However, there were no significant differences between the mean retention score of explicit teaching group and mind mapping group (M=7.00, SD=2.53), p=0.70. In the second paired comparison, the mean retention score of concept mapping group, (M=8.60, SD=3.68) was significantly higher than means of explicit teaching group (M=7.34, SD=3.68), and mind mapping students (M=7.00, SD=2.53), $p = 0.01$. The third paired comparison revealed that the mean retention scores of mind mapping group, (M=7.00, SD=2.53) and explicit teaching group, (M=7.34, SD=3.68) were not significantly different, p =0.07. However the mean retention score of mind mapping (M=7.00, SD=2.53) was significantly lower than concept mapping group (M=8.60, SD=), p=.0.01

Discussion

Results from data analysis on the effect of explicit teaching, concept mapping and mind mapping on students' motivation revealed that there were improvement of motivation among in the three groups of students as found by Caraan (2023) Hasan, khurram and Iqbal (2023) in respect of explicit teaching, Alamri (2021) in respect of concept mapping while Sari, Sumarmi, Utomo and Ridhiwan (2021) and Mamuju and Ali (2020) established this in respect of mind mapping. No significant difference was found in the mean motivation scores of the groups however, mind mapping group had a greater mean score gain than explicit teaching and mind mapping groups.. Regarding the effect of the three instructional approaches on students' academic achievement in Biology, concept mapping group significantly had a higher mean score as well as higher mean gain score compared to mind mapping. This finding however, is inconsistent with the findings of Marashi and Kangani (2018), Akbar and Taqi (2017), Tarkashvand (2015) and Zahra and Tarkashvand (2015), who found mind mapping instructional approach to have more impact in

enhancing students' achievement compared to concept mapping. However, the mean achievement scores and the mean gain scores of concept and mind mapping groups significantly surpassed that of the explicit teaching group. This most probably was due to the concept and mapping students' active involvement in graphical construction of the concept and mind maps as opposed to explicit teaching group who were actively involved more on paper-pen work involving writings during lessons.

On the three instructional approaches impact on students' retention of knowledge in biology, the three instructional approaches elicited the capacity to enhance knowledge retention as Australian Education Research Organization ([AERC] 2024) observed about explicit teaching. , Arokoyu and Obunwo (2014) and Agaba (2013) with concept mapping while Bawaneh (2019) and Balim (2013) with mind mapping. This study however found mean retention score and mean gain score of concept mapping group significantly surpassed the means of explicit teaching and mind mapping groups that were not significantly different

Conclusion.

This study comparatively investigated the effect of explicit teaching, concept mapping and mind mapping instructional approaches on students' motivation, achievement and retention of knowledge in secondary school biology. From the analysis of data, the study found that all the instructional approaches enhanced biology students' motivation however the impact was marginal. On the aspects of students' academic achievement and retention, concept mapping was most superior followed by mind mapping and then explicit teaching instructional approaches

Recommendations

Given the glaring superiority of the concept mapping instructional approach compared to explicit teaching and mind mapping pedagogies, this study recommends the use of student-centred concept mapping in teaching biology particularly when giving a general overview of a concept to be learned. For the sake of instructional variety, mind mapping is also recommended backed up with explicit teaching method

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REFERENCES

Achuonye, K. A. (2015). Predominant teaching strategyies in schools:Implication for curriculum implementation in mathematics, science and technology. academicjournals. http://www.academicjournal.org/ERR

Akinwumi, I O.; Olojo, O. J.,Falemu, F. A., Olu-Ajayi, F. E., Daramola, M. A.., Kenni, A. M., Ojo, A. A. (2024). The role of technology on Biology Education in Nigerian Secondary schools: A review. *Journal of Liaaning Technical University Natural Science Edition,* 1 (18);113-127. http://www.1gidxcn.asia/

Almulla, M. A. & Alamri M. M (2021). Using conceptual mapping for learning to affect students' motivation and academic achievement. *Sustainability 13(7).1307-4029* .http://doi.org/10.3390/su13074029

Arokoyu, A. A. & Obunwo, J. C. (2014). Concept-mapping: An instructional strategy for retention of organic chemistry concepts. *International Journal of Scientific Research and Innovative Technology*, *1*(3), 50-57.

Archer, A. L. & Hughes, C. (2024). *16 Elements of Explicit Instruction*. http://www.readingrockets.org

Academic Staff Union of Universities ([ASUU] 2025). ASUU queries schools over students' SSCE performance. http://www.businessday.ng>education>article

Australian Education Research Organization ([AERO] 2024). Explicit instruction. http://www.edresearch.ed.au

Balim, A. G. (2013). The effect of mind mapping applications on upper primary students' success and inquiry-learning skills in science and environmental education. *International Research in Geography and Environmental Education, 22*(4), 337-352. http//www. tandfonline.com

Batdi, V. (2015). A meta-analysis study of mind mapping techniques and traditional learning methods. *Anthropologist. 20*(1, 2), 62-68.

Benue State Government (2023). Student enrolment at the secondary school level in Benue State: Directorate of planning, research, statistics and computer.

Caraan, J. M. D. (2023). Effect of explicit instruction on mathematics achievement and motivation of Grade 9 Learners in La Trinidad Academy. *International Journal of Research Publication 12(1), 112-128 DOI 10.4719IJRP.0012917202235250.*

Centre for Teaching and Learning (2020). *Concept Mapping.* ctl.byu.edu>tip>concept .mapping

Hasan, Z.; Khurram B. A. & Iqbal, A. (2023). An impact of explicit teaching of reading strategies on reading motivation of Pakistani ELS learners. *Sir Syed Journal of Education and Social Research. 6 (2), 126- 137.* DOI:http://dci.org/10.30902/sjesr-vols-isse2-2023 (126-137)

Agaba, K. C. (2013). Effect of concept mapping instructional strategy on students' retention in biology. *African Education Indices, 5*(1), 1 – 8

Kola, A.J & Langenhoven, K. (2015). Teaching method in scienceeducation: The need for aparadigm shift tp peer instruction (PI) in Nigerian schools. International Journal of Academic Research and Reflection. 3(6), 2015; 6- 15. http://www.idpublications.org

Litemind (2019). *What is mind mapping? and how to get started immediately* https://litemind.com/what-is-mind-mapping/

Lucid (2019). *What is a concept map?* https://www.lucidchart.com/pages/concept-map

Mahasneh, A. M. (2017). The effect of using electronic mind mapping on chievement and attitudes in an Introduction to Educational Psychology Course. The New Educational Review 47 (1): 295-304 http//www.researchgate.net.

Marashi, H. & Kangani, M. (2018). Using concept mapping and mind mapping in descriptive and narrative writing classes. *Journal of Language and Translation.* 8 (2): 93 – 106

NSW Department of Education (2024). Theme 2-explicit teaching. http.//www.education nsw.gov au>what-works-best.

Oguejiofor, C. N. (2020). Effect of explicit instruction on student achievement and attitude towards basic science in Lagos State. *Online Journal of Educational. Science and Technology 1(2), 18-34*. www.//nojest.unilag.edu.ng

Pinola, M. (2013). *How to use mind maps to unleash your brains creativity and potential* https://lifehacker.com/how-to-use-mind-maps-to-unleash-your-brains- creativity-1348869811.

Sari, R., Sumarmi S., I, K. A., Utomo,D. H., & Ridhwan, R. (2021). Increasing students' critical thinking skills and learning motivation using inquiry mind map. *International Journal of Emerging Technologies in Learning* 16 (3), 4-19.http://doi.org/10.3991/ijet.v16i03.16515

Sundho, A. N, & Ali M. A. (2023). Effect of explicit teaching modelling on academic achievement of primary level students in mathematics: An experimental study in Gujrat Paskistan. *Annual Human and ocial Science 4 (2), 25-35 DOI: 10.35484/ahss.2023 (4-II) 04*

Shaimaa, S. A., Ahmed S. E. & Adel, E. (2018). The effect of concept mapping and mind mapping utilization on students' understanding level: *An empirical study proceedings. of the Eighth International Conference on Concept Mapping* Medellín, Colombia

Tarkashvand, Z. (2015). The comparative effect of mind mapping and concept mapping on EFL learners' vocabulary achievement. *International Journal of Scientific and Engineering Research, 6*(2), 652- 674 http://www.ijser.org

WETA (2019). *Concept maps*. http//www.readingrockets.org.

Zaferis, S. (2022). *What is explicit instruction and how can teachers use it?* http.//.www. getatomi.com.