

Unlocking the Potency of Copy-Cover-Compare Strategy on Senior Secondary Students' Spelling Skills in Biology: A Quantitative Analysis of Learning Outcomes

Oludipe Olajumoke S.¹, Yusoof, Raheem O.¹, Akindoju, Olugbenga G.¹, Saibu, Sakibu O.²

¹Department of Science and Technological Education, Lagos State University, Ojo

²Department of Natural Science Education, Lagos State University of Education, Oto/Ijanikin, Lagos

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ABSTRACT

This study investigated the efficacy of the Copy-Cover-Compare (CCC) strategy in enhancing senior secondary students' spelling skills in biology. It specifically looked into how students spelling deficiency in biology technical terms can be addressed using appropriate strategy to reduce cases of spelling errors and under-achievement in biology. Three research questions and three null hypotheses guided the study. The study adopted a pre-test, post-test, non-equivalent control group quasi-experimental design with a sample of 94 senior secondary year two biology students in two intact classes drawn from two purposively sampled senior secondary schools in Educational District V, Lagos State. The experimental group had 43 students (24 males and 19 females) and the control group 51 students (29 males and 22 females). Treatment consisted of teaching biological concept (ecology) which included functioning ecosystem, population study, growth measurement and soil properties to the experimental group using copy-cover-compare strategy while the control group was taught using the traditional lecture method. The treatment lasted for five weeks. Biology Students' Spelling Skills Test (BSSST) was used for data collection after subjected to both content and face validity, and with the reliability established using K-20 to yield a coefficient of 0.87. The research questions were answered with mean and standard deviation while the null hypotheses were tested using analysis of covariance (ANCOVA) at 0.05 level of significance. Results revealed that students taught using copy-cover-compare strategy performed significantly better in terms of spelling skills learning outcome than those taught by the traditional lecture method [$F(2,92)=28.9$; $P<0.05$] and no significant gender difference existed between spelling skills of students taught using copy-cover-compare strategy [$F(2,41)=.56$; $p>0.05$]. Consequently, no significant interaction effect of methods and gender on spelling skills of students was found [$F(2,138)=.19$; $p>0.05$]. The study concluded that the copy-cover-compare strategy enhanced senior secondary students spelling skills in biology and based on this finding, some recommendations were made to improve teaching and learning of biology and students proficiency at spelling ecological one-word technical terms to reduce errors in spelling.

Key words: Achievement, Biology, Copy-Cover-Compare Strategy, Lecture Method, Spelling Skills.

INTRODUCTION

Biology stands as a foundational science subject crucial for students' understanding of life and its interconnected systems, playing a pivotal role in shaping both individual futures and societal progress (Smith, 2017). Biology entails areas such as taxonomy, ecology, microbiology, vascular and non-vascular plants, vertebrates and invertebrates, cytology, physiology, genetics, among others (Bello et al., 2020). Among these various branches, ecology holds particular significance by exploring the intricate relationships between organisms and their environments, offering insights essential for environmental stewardship and sustainability (Brown & Jones, 2019). Mastery of biological concepts, including those in ecology, not only enhances students' academic achievement but also cultivates critical thinking and scientific literacy necessary for informed decision-making in a rapidly changing world (Beumer, 2019; Johnson, 2018). Thus, the relevance of the biologically based disciplines to socio-economic development made biology one of the most important subjects in our senior secondary school curriculum (Federal Ministry of Education, FME, 2014).

Thus, to study biology as a science subject, students have to develop scientific process skills and ethics to gain the requisite knowledge to achieve better in biology examination in secondary schools (Dempster, 2023; Bello, 2022; Mardonov 2019). However, despite the importance of biology, students often face challenges in mastering its terminology and concepts, leading to suboptimal academic performance and specifically, deficiencies in spelling accuracy (Martin, 2020; WAEC, 2020). This issue is particularly pronounced in specialized fields like ecology, where precise terminology is essential for comprehension and effective communication (Taylor et al., 2021). Traditional approaches to spelling instruction frequently rely on rote memorization, failing to engage students actively in their learning process and address the specific linguistic demands of scientific disciplines (Jones & White, 2016).

The poor achievement of senior secondary students in biology has been attributed to indices such as inadequate practical activities for students (Dangana & Mohammed, 2019) and too voluminous curricula content with many topics to cover before examinations (Eno, 2022), teachers inability to adopt active students friendly participatory strategies in biology class and not making biology teaching learning lively to boost students interest and achievement (WAEC, 2018; Cimer, 2012), and teachers teach biology with lecture method and all sort of didactic practices that are naive and monotonous as the lessons lack students active participation and activities (WAEC, 2020; 2018).

Apart from teachers not providing real life out of classroom learning experiences for students, which cumulate into poor achievement, wrong spelling of ecological and biological terms remain one of the important challenges students face in external examination (WAEC, 2020). Students' poor spelling drill in one word technical answers and labelling biological diagrams need special attention as most technical terms are of Latin and Greek origin. Victoria State Government Education and Training Department of Education and Training, and Victorian Curriculum and Assessment Authority (2016) argued that spelling is one of the integral part of every students' education that acts as the basis of all literacy education must be focused upon if a child or learner is to advance in his learning. Similarly, Bailey (2019) stressed in her study that spelling is the art of correctly assembling words from their letters, and one of the essential components of successful writing. When students are confident at spelling, leads to confidence in all aspects of literacy. Additionally, Jones (2009) claimed that for a students' to read fluently, there should be strong foundation in the sounds, represented by letters and their spelling. In line with this, Joshi et al. (2017) described the connection between spelling and reading in which they argued that learning to spell helps to cement the connections between letters and their sound, and learning high frequency sight words to mastery level improves both reading and writing. Thus, spelling instruction improve reading ability, as it is used in reading.

Teaching students strategies, rules and concepts to grow their spelling and vocabulary knowledge benefits them in all aspects of their learning in their everyday life. Students who feel confident with letters and word patterns are able to read and comprehend more complex texts. They also have the necessary language tools to better convey their own ideas through both written and verbal communication. In the context of senior secondary education, where students are preparing for higher education and professional careers, mastering discipline-specific vocabulary such as ecological terminology becomes paramount (Robinson, 2019). The ability to spell technical terms correctly not only demonstrates linguistic proficiency but also facilitates deeper understanding and application of ecological concepts (Harris & Patel, 2020).

In biology, many words and there terminologies are derived from either "Greek or Latin", which at times make it difficult to spell by students (Bailey, 2019). For instance, words such as haemoglobin is misspelt as hemoglobin, Malpighian as Malphighian, Vacuole as Vacoule, Nucleus as Nuclues, Meiosis as Meosis, Chlorophyll as clorophill, and plasmolysis as plasmolisis among many others. For this, biology terms such as autotrophs, heterotrophs, symbiosis, saprophytes, pseudopodia, eucaryote, that have their origin in Greek should be taught as vocabulary. Such words should be split into parts and students spell and pronounced before showing their meaning based on their etymology. More so, words like autotroph should be broken into "auto" meaning self and "troph" meaning nourish or feed, heterotroph should be broken down into "hetero" meaning different and "troph" meaning nourish, symbiosis should be spelt, then broken into parts as "sym" meaning together and "biosis" meaning life as in living together, poikilotherm is broken down into "poikilo" meaning varied, and "therm" meaning heat or temperature, poikilotherms are animals whose body temperature varies according to their environment and many more.

Zukswert (2019) has argued that many students become discouraged in secondary schools biology learning because of the complex vocabularies they need to memorized in order to understand the subject. Teachers of biology need to search for such words with both Latinised and Greek origin to be able to teach effectively the spelling of such words as vocabulary. Thus, teachers' handling of spelling skills to promote students' proficiency writing in biology is very crucial in the area of labeling biological drawings (Cimer, 2012). This is why teachers of biology, need to adopt activity-based spelling strategy such as copy-cover-compare to drill students on technical, one-word answer that test recall of knowledge in biology.

Copy-Cover-Compare (CCC) strategy according to Alptekin and Sonmez (2022) is a strategy where students are asked to look carefully, look at a word, cover it, and write it from memory. Students then compare their reproduction with the correct spelling. If the spelling is accurate, the students should move to the next word. But, if the word is misspelt the students should engage in positive practice before moving to the next word. Initially developed to improve general spelling proficiency. CCC involves students copying a target word or phrase, covering it, and then comparing their written version to the original, fostering accurate spelling through repetition and self-assessment (Harris & Patel, 2020; Jones & White, 2016). The repeated writing of a word helps the students establish a motor pattern for the word which would result in an automatic correct spelling (Westword, 2014). Consequently, the Copy-Cover-Compare strategy has emerged as a promising pedagogical tool within science education as an alternative to conventional approaches, leveraging principles of cognitive psychology to enhance students' spelling skills and overall learning outcomes through active practice and metacognitive reflection (Martin, 2020; Robinson, 2019).

Copy-Cover-Compare strategy has gained traction in educational settings for its simplicity and potential effectiveness in reinforcing accurate word formation (Taylor et al., 2021). In the context of biology education, CCC can be adapted to focus on biological terminologies, reinforcing students' understanding and retention of crucial scientific vocabularies. According to Wilson and Clark (2022), understanding how CCC influences spelling proficiency in biology is essential for teachers aiming to optimize instructional strategies and enhance students' learning outcomes. Thus, this quantitative study aimed to contribute empirical evidence on the impact of CCC specifically on senior secondary students' spelling skills in biology and by focusing on ecological terminologies; this study sought to fill gaps in existing literature by providing insights into the effectiveness of CCC in a specialized educational context.

Specifically, the objectives of the study are to:

1. determine the main effect of copy-cover-compare, and conventional method on senior secondary students spelling skills in biology.
2. determine the main effect of gender on senior secondary students spelling skills in biology when taught with copy-cover-compare strategy.
3. examine the interaction effect of treatment (copy-cover-compare strategy and conventional method) and gender on senior secondary students spelling skills in biology.

Research Questions

1. What is the effect of methods (copy-cover-compare strategy and conventional method) on senior secondary students spelling skills in biology?
2. What effect has gender on senior secondary students spelling skills in biology when taught with copy-cover-compare strategy?

Null Hypotheses

H₀₁: There is no statistically significant effect of copy-cover-compare strategy and conventional method on senior secondary students spelling skills in biology.

H₀₂: There is no statistically significant effect of copy gender on senior secondary students spelling skills in biology when taught with copy-cover-compare strategy.

H₀₃: There is no statistically significant interaction effect of methods (copy-cover-compare strategy and conventional lecture method) and gender on senior secondary students spelling skills in biology.

METHODOLOGY

The study adopted a pre-test, post-test, non-equivalent control group quasi-experimental design with a sample of 94 senior secondary year two biology students in two intact classes drawn from two purposively sampled senior secondary schools in Educational District V of Lagos State. A purposive sampling technique was used to select two senior secondary schools which have school garden/farm and other ecological learning spaces within the schools to study ecology. The experimental group had 43 students (24 males and 19 females) and the control group has 51 students (29 males and 22 females).

Students' Spelling Skills Test (SSST) which had closed item questions in which students fill in the missing words to test their spelling proficiency in ecology, was used to collect data. The spelling related questions used active words such as mention, list, state, and give among others to draw the questions. The questions were drawn from past WASSCE and NECO (2015 - 2020) that have one word technical terms (vocabulary) as the answer. These one-word vocabularies test students spelling proficiency. These questions covered four areas in ecology such as functioning ecosystem, population study, measuring ecological factors, and instruments in the habitats, measuring growth rate and soil properties. In all, there were five questions made up of cloze test item where students fill the missing gaps with the appropriate word to show the correct spelling of the responses. Students were made to write out the answers on their own, no multiple choice since the questions aimed at testing proficiency of students in spelling of technical terms in ecology. The instrument was subjected to both content and face validity while the reliability was established using K-20 to yield a coefficient of 0.87.

The SSST was administered on both the experimental and control groups as pre-test before treatment which five weeks. This was followed by the treatment in the both groups. The experimental group was taught biological concept (ecology) which included functioning ecosystem, population study, growth measurement and soil properties using copy-cover-compare strategy while the control group was taught using the traditional lecture method. Teacher's Instructional Guide on Copy-Cover-Compare Strategy was used to teach the treatment group while and Teacher's Instructional Guide on Lecture Method was used to teach the students in the control group.

The lessons in experimental group were divided into two. The first lesson was held in the biology laboratory in which students' were drilled in spelling. The biology dictionary and students textbooks were the instructional materials used to explain conceptual meaning. After the previous knowledge and introduction of the topic during the class session, teacher wrote the vocabulary word to be spelt on the board. Secondly, the students copy the words, and thirdly, the students wrote out the original words into his/her book. He/she covers the words. Then, he writes out the word, and then compared the words whether it is correct with the original word on the board. Several words identified as vocabulary were practiced by the students to get the correct spelling of the technical words/vocabulary. A student who failed to obtain the correct spelling was asked to keep practicing until the spelling was correct. Such student moved to the next vocabulary and repeats the exercise until he/she get the word spelt and written out correctly. This lesson was taken at every successive topic treated in ecology. Students also worked in group with their leaders making presentations on a particular concept given to a group on ecology. Thus, the class was activity-based where the teacher facilitated and guided students conduct all through the lesson. Evaluation were carried out and assignment and project given.

In the other class session which took place on the school garden/farm (field study) is a practical class. Teacher introduced the topics and shared the previous knowledge with the students. Students also worked in group of five, with a leader. Students were asked to identify the major components of the ecosystem. The students were given different task on the field. They worked in group to identify biotic component and abiotic components. They also did group work with soil, took measurement of growth rate of some organisms and population study using quadrat. Students made presentation to the class on their findings. The teacher monitored and guided the practical session. Every technical terms or vocabulary mentioned by students during evaluation were spelt to see that the students got the spelling correctly. Thus, the CCC spelling group had spelling drills in the laboratory along with ecological field practical on the field using the school farm to generate activities. In

other words, the theoretical knowledge was fused with practical knowledge for effective learning which helped in fostering all the three domains of education (cognitive, affective and psychomotor). Each lesson lasted four 40munites.

In the control group who passed through the lecture method had no special spelling drills in all their ecology learning. After the conclusion of the lessons which lasted for four weeks, a post-test was administered to the two groups.

The research questions were answered with mean and standard deviation while the null hypotheses were tested with analysis of covariance (ANCOVA) at 0.05 significance level. The use of ANCOVA allows for comparism of means of the two groups while adjusting for one or more covariates (continuous variables) that might influence the dependent variable. This helps in isolating the effect of the independent variable (the group) by controlling for the impact of the covariates.

RESULTS

Research question one: What is the effect of treatment (copy-cover-compare strategy and conventional lecture method) on senior secondary students spelling skills in biology?

Table 1: Mean and SD of effect of treatment on student’s spelling skills in biology

Groups	N	Mean		Mean Diff.	SD		SD Dif.
		Post-test	Pre-test		Post-test	Pre-test	
CCC	43	62.56	36.77	25.79	15.33	11.63	3.70
LM	51	28.55	25.35	3.20	13.51	10.53	2.98

Research question 1 indicates the difference in students spelling skills before and after treatment between the CCC and lecture method groups. The result shows that students taught with CCC strategy had a better mean difference of 25.79 and a standard deviation difference of 3.70 spelling skill compared to students in lecture method who had a mean difference of 3.20 and a standard deviation difference of 2.98 in the post spelling skills in biology. To authenticate the significance of the above values, the null hypothesis I was tested.

H₀₁: There is no statistically significant main effect of copy-cover-compare strategy and conventional lecture method on senior secondary students spelling skill in biology.

Table 2: ANCOVA for effect of treatment on students’ spelling skills in biology

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Corrected model	36128.199	20	1806.410	12.161	.000	.67%
Groups	8404.585	2	4202.292	28.292	.000	.32%
Error	17824.240	92	148.535			

R Squared = .670 (Adjusted R Squared = .615)

In Table 2, the F-value associated with treatment showed that there is significant impact of copy-cover-compare strategy on senior secondary school spelling skills in biology [F(2,92)=28.29; p<0.05]. The R Squared shows that the independent variables accounted for 67.0% of the variation in students’ spelling skills in biology. The partial eta squared estimated indicates that the treatments accounted for 32.0% of the variance observed in the post spelling skills of students in ecology. Therefore, the null hypothesis which state there is no

statistically significant main effect of copy-cover-compare strategy on senior secondary students' spelling skills in biology is hereby rejected.

Research Question 2: What effect has gender on senior secondary students spelling skills in biology when taught with copy-cover-compare strategy?

Table 3: Mean and SD of the effect of gender on students' spelling skills in ecology

Gender	Groups	N	Mean		Mean Diff.	SD		SD Diff.
			Posttest	Pretest		Posttest	Pretest	
Male	CCC	24	59.63	32.12	27.51	12.42	16.21	-3.79
Female	CCC	19	66.26	42.63	23.63	8.75	22.32	-13.57

Table 3 shows that male students in the copy-cover-compare group had the highest spelling skills with a mean difference of 27.51 and SD difference of -3.79; followed by female students in the copy-cover-compare group with a mean difference of 23.63 and SD difference of -13.57. To ascertain if the impact was significant, null hypothesis two was tested.

Ho₂: There is no statistically significant main effect of copy gender on senior secondary students spelling skill in biology when taught with copy-cover-compare strategy.

Table 4: ANCOVA for effect of gender on students' spelling skills in biology

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Corrected model	36128.199	20	1806.410	12.161	.000	.670
Gender	83.846	1	83.846	.564	.454	.005
Error	17824.240	4	148.535			

R Squared = .670 (Adjusted R Squared = .615)

The F-value associated with post-achievement test in Table 4 shows no statistically significant main effect of gender on students' spelling skills in biology [$F(2,41)=.56$; $p>0.05$]. The R Squared shows that the independent variables accounted for 67.0% of the variation in students' spelling skills in ecology. According to the partial eta squared estimate, the treatment only contributed 0.5% of the variance in the students' spelling skills in ecology. Therefore, the null hypothesis which states that there is no statistically significant main effect of gender on senior secondary students' spelling skills in biology when taught using copy-cover-compare strategy is hereby not rejected.

Hypothesis 3

Ho₃: There is no statistically significant main interaction effect of methods (copy-cover-compare strategy and conventional lecture method) and gender on senior secondary students spelling skills in biology.

Table 5: ANCOVA of interaction effect of the treatment and gender on students' spelling skills in ecology

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Corrected model	36128.199	20	1806.410	12.161	.000	.670
Groups * Gender	55.381	2	27.691	.186	.830	.003

Error	17824.240	138	148.535			
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R Squared = .670 (Adjusted R Squared = .615)

Table 5 reveals no statistically significant interaction effect of methods and gender on students' spelling skills in biology with $[F(2,138)=.19; p>0.05]$. The partial eta square which is 0.3% also shows no interaction effect. There is no statistically significant interaction effect of treatment (copy-cover-compare and conventional method) and gender on senior secondary students' spelling skills in biology is hereby not rejected.

DISCUSSION OF FINDINGS

The study finding from hypothesis one reveals significant impact of copy-cover-compare strategy on senior secondary school spelling skills in biology. This result aligns with the study conducted by Althobaiti (2020), who found that using copy-cover-compare strategy helped students' spelling skill, made them better speller when the strategy was used to find out their effectiveness on improving student's spelling in English Language. Merrit, et al. (2012) and Mesmeh (2012) concluded that CCC produces positive result for students classified as at risk of dropping out. Similarly, Mclaughling and Derby (2011) found that the CCC spelling strategy helped increase the spelling accuracy for four high school students diagnosed with severe behaviour disorder. Hence, spelling technical words correctly is a very serious problem for students studying biology in our secondary schools. The teachers should persistently use the CCC spelling strategy as it has helped students' one-word vocabulary in ecology and improved.

The result of the finding from hypothesis two shows no statistically significant impact of gender on senior secondary students spelling skills in biology when taught using copy-cover-compare strategy. Justifying the finding, Lazarus and Audu (2023) on the effect of two instructional strategies on spelling performance of pupils with learning disabilities found that gender had no significant influence on pupils' spelling skills. Sabra (2018) and Mclaughlin (2015) in their separate studies found no effect of gender on young students spelling skills and achievement. Similarly, the study by Nkanor and Ekpo (2023), on gender and primary schools pupils spelling and reading performance showed that there was no significant influence of gender on their spelling in English language.

The result of the finding from hypothesis three depicts no significant interaction effect of copy-cover-compare strategy and gender on senior secondary school spelling skills in biology. In agreement with the finding, Ezeobi et al. (2020) discovered no significant interaction effect of gender on the mean achievement scores of students taught biology using lecture and discussion method. Consequently, the study conducted by Lazarus and Oguniola (2016) revealed no interaction effect of gender, metacognition and direct instruction on spelling abilities of pupils with learning disabilities in primary schools. This result showed that irrespective of individual students' background, attitude, and interaction effects of gender have no effects on students' achievement. A good strategy coupled with teachers' efficacy and exposure to activities may be a good drive to getting a good achievement in ecology and biology. Neither gender nor students attitudes is a strong determinant of students achievement in ecology or in spelling skill.

CONCLUSION AND RECOMMENDATIONS

The study established that the copy-cover-compare strategy significantly improved the students' spelling accuracy and proficiency and reduced spelling errors in biology class. Furthermore, it is evident from the findings of this study that no gender disparity exists in the students' spelling skills of students when taught with copy-cover-compare strategy. Based on this premisses, the study recommended:

- i. incorporation of the copy-cover-compare strategy to aid spelling proficiency and retention of facts in biology class.
- ii. encouragement of teacher training and professional development session to familiarise teachers with effective implementation of technique of the copy-cover-compare strategy.

- iii. fostering collaborative learning environment where students can share and discuss their interpretation of biological concepts. This not only reinforces the benefit of the copy-cover-compare strategy but also promotes a positive attitude towards team work and shared learning experiences.
- iv. equipping schools with more ecological equipment and facilities to promote students' interest and achievement in biology.

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