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Effects of Code-Switching Instructional Strategy on JSS Two Basic Science Students' Achievement and Retention in Bauchi Metropolis, Bauchi State

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ABSTRACT

The study investigated the effect of the code-switching instructional strategy on the academic achievement and retention of students in basic science in Bauchi Metropolis, Bauchi State, Nigeria. The study adopted a quasi-experimental non-equivalent control group design. A sample size of one hundred and thirty-seven (137) students was drawn from two randomly selected schools in the metropolis. The study was guided by two research hypotheses. The experimental group received the treatment (code-switching between English and Hausa languages). The instrument for data collection was the Basic Science Achievement Test (BSAT) administered as a pretest, post-test, and post-post-test. The BSAT consisted of 20 structured items (open-ended questions) on respiration and excretion, with a Cronbach alpha reliability coefficient of 0.75. Data were analyzed using mean, standard deviation, and t-tests. The data was first tested for normality using the Shapiro-Wilk test. Independent sampled t-test results indicated that there was a statistically significant difference between the two groups in favor of the experimental group on post-test achievement scores. Further analysis showed that there was a statistically significant difference between the retention scores of students in the two groups in favor of the experimental group. These results indicated that code-switching improves students' achievement and retention significantly. This study therefore recommends that the code-switching instructional strategy be adopted by basic science teachers in order to foster students understanding and consequently their achievement.

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INTRODUCTION

The contemporary era is defined by progress in science and technology. This indicates that for Nigeria to realize its goals of economic, political, and cultural development, there is a necessity for high-quality science instruction in educational institutions, particularly in basic education, which leads to a robust educational foundation. The urgent demand for changes and innovations in scientific education seeks to enhance the quality of science instruction in Nigeria. This indicates that deficiencies exist in science education, necessitating enhancement, as no nation can progress without high-quality science education. This perspective is supported by Rull (2014), who asserted that society values science due to its use of scientific knowledge in fulfilling fundamental human needs and enhancing living conditions. Quality scientific literacy among the people cannot be achieved without a solid basis for teaching science to the younger generation. Fundamental education constitutes the cornerstone of great education. Amadioha and Akor (2018) affirm that basic education constitutes the foundational level of education. This may also be seen as the most essential education provided to individuals. They asserted that fundamental education is the foundational instruction upon which all subsequent educational progress relies. Basic education in this perspective serves as the foundation of a construction, supporting all subsequent weights. The fundamental education derived from inference establishes the solidity of the overall educational framework that one can possess. This elucidates the significance of basic science in junior secondary education. The role of basic science as the foundation for all scientific disciplines in secondary schools, and therefore in higher institutions, has resulted in its incorporation into Nigeria's educational curriculum. To reinforce the focus on science and technology education in the national education strategy, basic science has been mandated as a topic for all Nigerian pupils at the basic school level. The basic science principles are systematically organized into themes, eliminating content duplication and needless repetition across many scientific fields, stimulating curiosity, and fostering scientific interests and abilities in pupils. This aims to assist youngsters in cultivating reflective thinking and beneficial behaviors essential for the scientific method and a prosperous future (Agogo & Ode, 2011). Basic science aims to equip children with specific scientific process skills, including observation, information organization, generalization based on acquired data, prediction derived from generalization, and experimental design to verify predictions (FRN, 2013). Basic science is a discipline that is seen as essential for providing students with a foundational education and highlights the significance of observation for enhanced comprehension of the environment.

The basic science curriculum encompasses a comprehensive integration of several scientific disciplines, including biology, chemistry, physics, astronomy, geology, and environmental science, to present a cohesive and coherent understanding of science (FRN, 2013). The comprehensive, multidisciplinary, industry-focused model positions students at the core of the educational experience and effectively alleviates the widespread apprehension associated with the study of science. The objective of the basic science curriculum is twofold:

to deliver a robust general education for all Nigerian students and to establish a solid basis for those who will pursue further studies in key scientific topics, such as biology. Basic science is imparted in elementary and junior secondary schools to engage students at an early age. This aims to assist youngsters in cultivating reflective thinking and beneficial behaviors essential for the scientific method and a prosperous future (Agogo & Ode, 2011). The basic science curriculum instills appropriate values and societal standards to promote growth. Notwithstanding the significance of science and technology in the nation's pursuit of technological progress, there persists a pattern of deficient execution of the fundamental scientific curriculum attributable to insufficient competences. The incompetence noted by Chima (2021) includes insufficient laboratory resources, inadequate instructional materials, and ineffective teaching methods, among others. He asserted that the majority of basic science educators employ traditional teaching methods, which have proven inadequate in facilitating learning and fulfilling the objectives of the basic science curriculum. The inquiry approach is seldom employed in education. Educators predominantly depend on traditional teaching methods due to insufficient equipment and materials for practical activities, compounded by the fact that many teachers lack proficiency in using the available resources for such work. Chima observed that a significant problem confronting the implementation of the Basic Science Curriculum is the necessity for students to investigate, innovate, forecast, and regulate occurrences. Amos, Folasayo, and Oluwatoyin (2015) examined the pedagogical strategies employed by educators in facilitating instruction and observed that teachers struggle to implement suitable instructional methods in the classroom, which adversely affects students' academic performance. The latest 2019/2020 Basic Education Certificate Examination (BECE), in which over eight thousand five hundred fifty-three (8553) applicants failed, substantiates this claim (Musbahu, 2021). This may be ascribed to the ineffective teaching tactics utilized by educators. Isa, Mammam, Badar, and Bala (2020) further validated that the pedagogical tactics employed by educators influence the degree of student academic performance. Therefore, to enhance students' interest and academic achievement in basic science, it is essential to implement new tactics that offer hands-on learning experiences for successful instruction in the field. Basic science educators must implement strategies that enhance student learning, improve information retention, and facilitate the application of acquired knowledge to real-world scenarios. Carlos (2010) proposed that code flipping might be a valuable opportunity in this context. The phrase code-switching fundamentally refers to the incorporation of many languages inside a single statement. It is the habit of switching between two or more languages or dialects during a discussion. Carlos (2010) characterized code switching as the transition from one linguistic code to another based on the social context or conversational environment. The use of learners' first language (L1) or mother tongue in a classroom where the medium of instruction differs from their primary language.

Code flipping facilitates knowledge transfer between learners and teachers, preventing scenarios where the teacher conveys the subject matter in English to a passive learner (Mzamani, 2019). Code-switching has garnered

significant scholarly interest in the last decade. Code-switching denotes the use of many codes or languages throughout a singular speaking occurrence (Abu Hait, 2014). In educational contexts, code-switching has been shown to be beneficial for both informational and interpersonal communication goals. Research indicates that code-switching is employed to address understanding deficits stemming from students' insufficient skill in language and scientific courses (Promnath & Tayjasanant, 2016). In Malaysia, research indicated that science and mathematics educators engaged in code-switching to Bahasa Malaysia and solicited assistance from English instructors when faced with challenges in elucidating concepts in English (Yahaya, 2019). In addition to enhancing science instruction, code-switching has been employed for interpersonal communication within the classroom. Code-switching is employed to express humor, commendation, motivation, initiate conversation, and reprimand in the classroom (Then et al., 2011).

Stromvig (2018) contended that code-switching is a vital instrument in the classroom for educators and students utilizing a second language as the medium of instruction, as it enables the negotiation of meaning, thereby enhancing interaction between the teacher and students, as well as among the students themselves. They contended that utilizing African languages as mediums of teaching in science may eradicate the significant divide between the privileged English-speaking classes and the general populace. Other research, including Moore (2002), indicates that analogous shifts provoke varied interactive responses; hence, code flipping may facilitate the connection in conversation. It may be more successful in teaching basic science and improving learners' academic performance. Academic accomplishment refers to the performance results that demonstrate the degree to which students attain designated objectives fundamental to classroom activity. Students' performance in basic science and technology serves as a modest predictor of the quality of scientific education, particularly at advanced levels in subjects such as biology, physics, and chemistry, as asserted by Enemarie et al. (2019). Academic success is assessed by teacher-created assessments or standardized examinations. Educational or academic accomplishment refers to the designated level of competency in academic endeavors as assessed by the educator (Chamundeswari & Franky, 2015).

Academic accomplishment refers to the extent of learners' performance on cognitive activities, specifically their ability to exhibit mastery of their topics in relation to a predetermined benchmark. The responses to this inquiry can be derived from a test or its findings. Academic accomplishment is significant; it is crucial to consider when assessing all teaching-learning activities, as inadequate academic performance equates to academic failure. The Cambridge University Reporter (2003) often defines academic performance as the outcomes of an examination. Academic accomplishment is defined as prior learning that can be measured through assessments, portfolios, and expert evaluations. While information from a descriptive assessment is typically converted into a grading system like GPA or subject grades to evaluate student success in formal education, academic achievement is a pedagogical term employed to assess the

extent and effectiveness of students' learning through research, reports, experiments, and various evaluative factors (Omotere, 2011).

Considering the essential functions of science education in individual lives and national development, it is imperative for science educators to formulate a comprehensive strategy that improves science instruction and learning in the classroom, ensuring inclusivity for all students regardless of gender and promoting retention among learners. When suitable teaching tactics are utilized, they significantly impact students' retention capabilities. Udu et al. (2022) determined that the implementation of active learning instructional methodologies in scientific education can improve students' knowledge retention. This highlights the efficacy of involving students in the learning process via interactive and participatory strategies to enhance knowledge retention. Retention in learners denotes the capacity of pupils to remember and retrieve information over time. It includes the ability to retain knowledge gained from learning events and access it when required. Multiple factors affect learner retention, encompassing instructional tactics, cognitive processes, and individual traits. The research elucidates how various methodologies and tactics might influence students' retention of knowledge in different educational environments. A key factor that substantially affects retention is the manner in which information is presented. Studies indicate that learners are more inclined to retain knowledge in their working memory when texts and visuals are provided concurrently (Mohafa et al., 2022). This suggests that the method of information delivery might influence pupils' retention and internalisation of the material. Employing suitable teaching techniques, such as code-switching, can improve students' performance and retention in fundamental science at the junior secondary school level.

Statement of the Problem

The teaching of basic science in junior secondary schools in Nigeria, particularly in Bauchi State, has been with the use of outdated methods of instruction, which makes it difficult for students ’to effectively understand some basic science concepts. This has led to poor academic achievement and retention of students in both internal and external basic science examinations, as basic science BECE results from 2015 to 2020 have shown that there is a need for improvement. In view of the usefulness of basic science in all fields of science, the poor performance of students and lack of interest of students ’in choosing science at the senior secondary school level and higher institutions are of significant concern to stakeholders in education, particularly at this secondary school level. Dinah (2013) stated that most of the time the poor achievement of students ’and their interest in basic science can be attributed to many factors, such as infrastructure and teaching method, which means classes are congested and the teaching methods are not learner-centered or appropriate to motivate learners. Therefore, this study sought to determine the effects of the code-switching instructional strategy on JSS two basic science students’ achievement and retention in Bauchi Metropolis, Bauchi State.

Research Hypotheses

The study was guided by the following null Hypotheses which were tested at 0.05 level of significance;

(i) There is no significant difference between the mean achievement scores of students taught basic science using code-switching instructional strategy and those who were not taught with code-switching instructional strategy.

(ii) There is no significant difference between the mean retention scores of students taught using code-switching instructional strategy and those who were not taught using code-switching instructional strategy.

METHODOLOGY

Participants and Sampling Methods

This study employed simple random sampling techniques to select two junior secondary schools from all the junior secondary schools in Bauchi Metropolis. The selected schools were matched in terms of teacher qualifications, student demographics, school facilities, and academic performance, as determined by site visits and examination of national examination records. The study included two experienced teachers (holding bachelor's degrees with over five years of teaching experience) and a sample of 137 students, comprising 75 males and 62 females, with a mean age of 11.5 years (SD = 1.124). The control group consisted of 73 students, while the experimental group comprised 64 students. Intact classes were used so as not to disrupt normal academic settings of the schools used. A pretest was administered to establish a baseline and ensure equivalence in academic achievement between the two groups.

Measures

This study collected data on academic achievement using a Basic Science Achievement Test (BSAT) administered at pre-test, post-test, and post-post-test design. The researchers developed the test instruments by adapting questions from the basic science scheme of work. The tests consisted of 20 structured items (open-ended questions) on respiration and excretion, with a Cronbach alpha reliability coefficient of 0.75, indicating good internal consistency. Experts from the University of Abuja's Department of Science and Environmental Education and participating basic science teachers established content and face validity. The Basic Science Achievement test was reshuffled and used for the post-test and retention test. The study instrument was piloted on 53 students in a school that was not part of the schools used for the study to establish content validity. The main study employed a quasi-experimental design, using a non-equivalent control-group design, due to the challenges of random assignment. Both groups were pre-tested and post-tested for academic achievement and retention, with the experimental group receiving the code-switching instructional strategy (the use of the English language and the Hausa language interchangeably) while the control group received no treatment in addition to conventional teaching methods.The students in the experimental group engaged in active learning methods, such as experiments, group discussions, inquiry learning, and collaborative learning, which were enhanced by code-switching instruction

aligned with the lesson's learning objectives. The teacher also allowed the use of code-switching during their discussion and asking questions. In contrast, the control group received the same active learning methods without code-switching. To control for the Hawthorne effect, each teacher taught their respective classes in their own schools after they were trained by the researchers on how to implement the lessons designed for them. The code-switching instructional strategy was implemented through a structured approach, involving outlining learning outcomes, probing prior knowledge, eliciting learning processes, and consolidating understanding. After six weeks, both groups underwent post-testing and post-post-testing.

Data Analysis

The achievement test consisted of 20 multiple-choice questions, with answers scored based on Bloom's taxonomy levels. Scoring ranged from 0 (wrong) to 4 (excellent), with a total possible score of 80. Student scores were converted to percentages and used in t-tests to compare pre-test and post-test results between groups. The independent t-test determined significant differences between groups, while Cohen's d test measured effect size. Linear regression analysis was used to determine if the intervention, rather than student characteristics, drove changes in academic achievement, controlling for student variables to isolate the intervention's impact. Data were analyzed using SPSS version 26.

RESEARCH RESULT

The results of the pre and post-tests on academic achievement were summarized and analyzed. The data was first tested for normality using the Shapiro-Wilk test, and then analyzed using a t-test to compare means. Additionally, linear regression analysis was conducted to further examine the relationships between variables, after confirming that the data met the normality assumption.

Table 1: Descriptive Statistics of Achievement Scores between the Experimental and Control Groups

Group	Pretest Mean	N	STD	Post-test Mean	N	STD
Experimental	33.47	64	5.67	55.76	64	4.34
Control	35.73	73	5.43	39.83	73	5.47

The descriptive data of the pre-test and post-test mean scores on academic achievement was analyzed and presented in the table above. The mean on the pre-test of the experimental group was 33.47 with standard deviation of 5.67 and the control group was 35.73 with standard deviation of 5.43, while the post-test mean scores of the experimental group was 55.76 with standard deviation of 4.3 and the post-test mean score of the control group was 39.83 with standard deviation of 5.47. The experimental group obtained a higher mean gain score than the control group

Table 2: Results of the Independent Sampled t-test of the pre and post test scores between groups and test of equality of means

	t	Df	*P*-Value	Mean Difference	Cohen's *d*
Pre-test	0.042	135	0.966	2.26	0.3
Post-test	15.93	135	0.000	15.93	2.3

A *t*-test of independent samples on the pre-test showed no significant difference between the control and experimental groups with $t = 0.066$, $p = 0.966$ with the lowest Cohen's *d* value of 0.3 The pre-test scores were not statistically different between the groups. The independent sampled test of the post-test between the groups showed significant changes between the group, $t=15.93$, $p < 0.000$]. Cohen's *d* test was calculated to find the effect size of the treatment in this study. The effect size of the treatment calculated using Cohen's *ds* formula was 2.3, which is a very large effect size of the treatment. The Cohen's *d* of 2.3 is a 85-90% nonoverlap of the test score distribution between the participating groups (Cohen, 1988). Which means the experimental group perform approximately 85-90% better than the control group

Hypothesis Two:

Table 3: Descriptive Statistics of Retention Scores between the Experimental and Control Groups

Group	Post-test	N	STD	Retention score	N	STD
	Mean			Mean		
Experimental	55.76	64	4.34	53.76	64	3.67
Control	39.83	73	5.47	28.53	73	8.34

The results in table three above indicated that the experimental group had a retention mean score of 53.76 with standard deviation of 3.67 while the control group had retention mean score of 28.53 with a standard deviation of 8.34. The difference between the post-test mean score and retention mean score of the experimental is 2 in favour of the post-test. Although there was slight reduction in the retention mean score compared to post-test mean score, it can be inferred that students in the experimental group retained about 90% of the knowledge gained in the post-test achievement mean score. This implies that code-switching instructional strategy is effective in enhancing the retention ability of students in basic science

Table 4: Results of the Independent Sampled t-test of retention scores between groups

	t	Df	*P*-Value	Mean Difference	Cohen's *d*
Post-test	15.93	135	0.000	15.93	2.3
Retention Test	13.93	135	0.000	25.23	3.5

The result in Table 4 shows that a t-score of 13.93 with associated probability value of 0.000 was obtained with respect to the difference in the mean retention scores of students` taught basic science using code-switching instructional strategy and those taught with lecture method. Since the associated probability

(0.000) was less than 0.05 level of significance set as the criterion for taking a decision, the null hypothesis (HO2) was hereby not accepted. It was therefore concluded that there is a significant difference in the mean retention scores of students taught basic science using code-switching instructional strategy and those taught without using code-switching strategy

DISCUSSION

The major objective of the study was to assess the effect of the code-switching instructional on the academic performance and retention of students in basic science within Bauchi Metropolis, Bauchi State, Nigeria. An analysis of data about students' academic success and retention in basic science revealed that the levels of academic accomplishment were the same at the commencement of the study and throughout the pretest. The data analysis indicated that the code-switching instructional strategy can enhance academic performance and retention among students. The data analysis in this study has demonstrated that learners in the experimental groups exhibit substantial improvements in academic accomplishment compared to those in the control group. The Cohen's d analysis of the t-test indicated a significantly high effect size of 2.3, suggesting that the disparities in student performance between the groups are attributable to the treatment. An additional test was conducted to determine if the variations in student results were attributable to student characteristics (composition) or the treatment in quasi-experimental research, as posited by Theobald & Freeman (2014). The regression analysis indicated that the variations in students' scores were attributable to the therapy. The regression analysis indicated that the intervention was statistically significant ($p < 0.01$) for the student post-test scores, resulting in an increase of 51.21 scores in the post-test score for each unit increase in the treatment.

The study presents an effective intervention technique to enhance students' academic success and retention in fundamental science. This observation aligns with the findings of Carlos (2010) and Promnath (2016), who highlighted the importance of code-switching instructional interventions in fostering meaningful learning. Learning based on code-switching enhances students' comprehension of material information, hence influencing their academic performance and retention capacity. Thus, the study explains the influence of code-switching in basic scientific education on students' academic performance and their learning experience. The performance of students in the experimental group post-treatment underscores the importance of employing code-switching training in the classroom to engage learners and effectively enhance their receptiveness to new knowledge.

The results of this study are highly relevant to Nigeria's education system, as they correspond with the policy of involving learners in their native language or the language of their immediate environment at the basic education level. The study is significant globally, as it demonstrates the essential role of code-switching in improving academic performance and retention among basic science students. Students' involvement, curiosity, interest, and academic performance were enhanced throughout the research. They got the opportunity

to observe abstract topics in fundamental science represented more clearly than in basic science textbooks.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The use of code-switching interactive teaching enhanced the academic performance and retention of basic science students in the experimental groups compared to the control group. The enhancement in academic performance and retention among students in the experimental group illustrates the beneficial effects of Code-switching based instruction on the cognitive and emotional aspects of motivation as indicated by the variables assessed in this study. The study's results indicate that code-switching pedagogy enhanced learning outcomes. Therefore, if educators can investigate and integrate code-switching into their instruction of fundamental science, comprehension may be enhanced as abstract and complicated topics will be elucidated in a language that students grasp well, resulting in more meaningful learning.

Recommendations

The research advocates for schools to promote the implementation of code-switching as an instructional approach by instructors in fundamental scientific education to improve students' comprehension of the subject at the foundational level. This will enable students to establish a robust foundation that will facilitate the advancement of cognitive and emotive domains in the learning process, as corroborated by the study findings and the cognitive-affective theory of learning within the constructivist framework.

REFERENCES

Abu-Hait, S. (2014). *The Functions of Code Switching Used by Secondary Students in English Classes:* MA Thesis is Submitted in Partial Fulfillment of the Requirements for the Master of Arts Degree in English Language and Literature, Faculty of Arts and Sciences, Department of English Language and Literature, Middle East University, June 2014. GRIN Verlag.

Agogo, P.O., & Ode, J.O. (2011). Issues in Nigeria Integrated Science curriculum. Makurdi: Optimisson Press. Ajayi, V.O. (2017). Effect of hands-on activity-based method on interest of senior secondary students in organic chemistry. Scholarly Journal of Education, 6(1), 1-5

Amadioha, S.W. & Akor, V.O. (2018). Globalisation and functional education in Nigeria. In Tabotndip, J.E., Umo, U. & Nwiyi, G.U. (eds), Globalisation and functional education in Nigeria. Onitsha: West and Solomon Publishing Company Limited.

Amos, A. A., Folasayo, O. A., & Oluwatoyin, A. E. (2015, July). Instructional strategies for effective teaching and learning in Nigeria secondary schools. In *First Asia-Pacific Conference on Advanced Research*.

Banda, H. J., & Nzabahimana, J. (2023). The impact of physics education technology (PhET) interactive simulation-based learning on motivation and academic achievement among malawian physics students. *Journal of Science Education and Technology*, *32*(1), 127-141.

Carlos, D.M (2010). Code-Switching. https://www.britannica.com/topic/code-switching

Chamundeswari, S., & Franky, D. (2015). An empirical investigation of effective science learning through simple experiments. *International Journal of Indian Culture and Business Management*, *11*(4), 422-439.

Chima, T. S. (2021). Basic science curriculum and development in Nigeria: Post covid-19 challenges and prospects. *Unizik Journal of Educational Research and Policy Studies*, *7*, 100-114.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Lawrence Earlbaum Associates.

Dinah, C. S. (2013). Factors which influence academic performance in biology in Kenya: a perspective for global competitiveness.*International Journal of Current Research,* 5(12), 4296 - 4300.

Enemarie, V., Ajayi, V. O., & Ogbeba, J. (2019). Students' achievement in basic science and technology as a predictor of quality science education. *International Centre for Science, Humanities and Education Research Journal (ICSHERJ)*, *4*(2), 178-187.

Federal Republic of Nigeria (FRN) (2004). *National Policy on Education*. Lagos: NERDC Press

Isa, S. G., Mammam, M. A., Badar, Y., & Bala, T. (2020). The impact of teaching methods on academic performance of secondary school students in Nigeria. *International Journal of Development Research*, *10*(6), 37382-37385.

Mohafa, L. G., Qhobela, M., & George, M. J. (2022). Evaluating the influence of interactive simulations on learners' academic performance in stoichiometry. South African Journal of Chemistry, 76, 1-8. https://doi.org/10.17159/0379-4350/2022/v76a01

Moore D 2002. Case study: Code-switching and learning in the classroom. International Journal of Bilingual Education and Bilingualism, 5(5): 279–293. Available at https://www.researchgate.net/profile/Daniele_Moore2/publication/261586361_Codeswitching_and_Learning_in_the_Classroom/links/54dd07cd0cf28a3d93f88c64.pdf. Accessed 30 August 2019

Mzamani, M. J. (2019). Using code-switching as an empowerment strategy in teaching mathematics to learners with limited proficiency in English in South African schools. *South African Journal of Education*, *39*(3).
org/10.4324/9780429340321

Promnath, K., & Tayjasanant, C. (2016). English-Thai code-switching of teachers in ESP classes. *Pasaa*, *51*(1), 96-125.

Rull V. (2014). The most important application of science: As scientists have to justify research funding with potential social benefits, they may well add education to the list. *EMBO reports*, *15*(9), 919–922. https://doi.org/10.15252/embr.201438848

Stromvig, H. (2018). *The functions of teacher code switching in classrooms, and teachers' perceptions towards this practice: A case study of siSwati-English interactions in a semi-urban high school in Eswatini* (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Theobald, R., & Freeman, S. (2014). Is it the intervention or the students? Using linear regression to control for student characteristics in undergraduate STEM education research. *CBE – Life Sciences Education*, *13*(1), 41-48.

Then, D. C. O., & Ting, S. H. (2011). Code-switching in English and science classrooms: More than translation. *International Journal of Multilingualism*, *8*(4), 299-323.

Udu, D. A., Nmadu, J., Uwaleke, C. C., Anudu, A. P., Okechineke, B. C., Attamah, P. C., … & Ogonna, O. C. (2022). Innovative pedagogy and improvement of students' knowledge retention in science education: learning activity package instructional approach. Pertanika Journal of Social Sciences and Humanities, 30(3), 1404-1426. https://doi.org/10.47836/pjssh.30.3.25.