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HANDS-ON STRATEGY AS A CATALYST FOR IMPROVING STUDENTS ACHIEVEMENT IN BIOLOGY AMONG SECONDARY SCHOOLS IN OBAFEMI-OWODE LOCAL GOVERNMENT AREA OF OGUN STATE, NIGERIA

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ABSTRACT

Practical exploration has been propagated in the National Policy on Education for Critical thinking enquiry, creativity and innovation in order to reinforce effective teaching of science education. In consequence, the study investigated Hands-on strategy as a catalyst for improving students' achievement in Biology. The study adopted a pre-test, post-test, control group quasi-experimental design using 2 x 2 factorial matrix. The samples of the study consisted of fifty (50) students in intact classes from two senior secondary school II offering Biology in co-educational senior secondary schools while Biology Achievement Test (BAT, 0.64) was used for data collection. The BAT was a 30 item objective test constructed by the researcher with the coefficient of 0.64 index. The research was carried out within four weeks. Data collected were analyzed using Analysis of Co-variance (ANCOVA) at 0.05 level of significance. There was significant effect of instructional strategy on students' achievement in Biology ($F_{(1, 47)} = 7.268$, $P < 0.05$); the 2-way interaction effect of Hands-on and gender was not significant on students achievement in Biology ($F_{(1, 47)} = .084$, $P > 0.05$). This outcome implies that student post-test mean achievement scores in Biology in the levels of treatment (Hands-on and control) did not vary across the two levels of gender (male and female). The study concluded that Hands-on strategy led to improved students achievement in Biology while the effect of gender was not significant. It was recommended that teachers should be provided with adequate training and support to ensure they can effectively implement Hands-on strategy in their teaching. Professional development workshops, sharing best practices, and mentoring opportunities can help educators feel confident and competent in utilizing these techniques. Collaborative and supportive learning environment should be fostered, where students are encouraged to explore, ask questions and learn from their mistakes to enhance the benefit of Hands-on learning experience in Biology.

Keywords: Nation-building, Humankind, Gender, Activity-based, Intact class.

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INTRODUCTION

The study of biology has made a significant contribution to nation-building as well as the economical, physical and artistic benefits of humanity. Given the significance of biology to humankind, students are expected to demonstrate a high degree of proficiency in this subject in both internal and external ex-

aminations.

Importance of Biology to man and environment does not allow for students to record poor performance in the subject. However, students' achievement in Biology subject in Senior Secondary Certificates Examination (SSCE) has been unsatisfactory over the years (Tom-Jones, 2024).

According to Agboghoroma and Oyovwi (2015), students' performance over time in science, particularly biology, has not been particularly spectacular for the West African Examination Council (WAEC) and National Examination Council (NECO). For example, in the Senior Secondary Certificate Examination (SSCE) results administered by the West African Examination Council (WAEC), students' academic performance in science in general and Biology in particular has improved over time (Table 1). However, relatively few students outperformed their peers in the biology examination (Hajia et al., 2018). Teachers also complained of students' low performance at both internal and external examinations.

Table 1: Students Performance in Biology between 2013 and 2018

Year	No of students present	No of students passed	No of students failed	% passed	% failed
2013	182659	39125	143534	21	79
2014	228953	80355	148598	35	65
2015	250099	86150	163949	34	66
2016	289520	84520	205000	29	71
2017	326541	98215	228326	30	70
2018	367562	120560	247002	33	67

Source: WAEC Office (2018), Research Department WAEC Office, Lagos

The level of knowledge retained by the students from biological concepts that they have been taught are not sufficient. Also, students' attitude has been found to have relationship with their achievement. Attitude could be positive, negative or neutral. Any concept that specifies an individual's feeling of likeness or dislike to anything is termed his/her attitude towards that item. Scholars have suggested a number of causes for this issue. Dinah (2018) ascribed it to the problem of a lack of textbooks, laboratory equipment, and other educational tools. Akinsanya et al. (2019) attributed students' poor academic performance to their parents' education, whereas Manalanga and Awelani (2019) related it to lack of funding, poorly equipped libraries, a lack of laboratories and biology textbooks, as well as ineffective teaching and assessment strategies. Thus, the teachers' ability to use appropriate technique to improve students' achievement in Biology becomes essential. Teaching techniques are the various ways that students might acquire knowledge, skills, and other things under the direction of a teacher. According to Uche and Awujo (2019), an effective instructional technique creates a richer

learning environment, which leads to improved learning outcomes. The selection of a teaching method for a specific topic is contingent upon the teacher's training regimen. Numerous researches have demonstrated a significant correlation between teaching methods and the substandard academic achievement of students in the field of fundamental science (Igboanugo, 2021).

Hands-on approach has been identified as an essential strategy that has in-built mechanisms to ignite students' achievement. It has been proposed as a means to increase students' academic achievements and understanding of scientific concepts by manipulating objects which may make abstract knowledge more concrete and clearer. The Hands-on method is a teaching strategy that promotes experiential learning among students. This is to provide the students with opportunities to engage with the materials they are studying which include mathematical sets, shapes, magnetic fields, plants, insects, rocks, and water. Ekwueme et al. (2015) pointed out that Hands-on strategy is a way to actively participate in Science and Mathematics in the classroom likewise Haury and Rillero (2015) says a child in a comprehensive learning experience through Hands-on activities can improve their critical thinking skills. Ekwueme et al. (2020) noted that some teachers object to the use of interactive activity-oriented methods, claiming that it takes too much time and does not allow for a thorough presentation of the curriculum content. However, because learner-centeredness is strongly encouraged, the new basic science syllabus' coverage is determined by how much knowledge and skills students have acquired rather than the coverage of the syllabus. The preceding remark was supported by Obanya (2018) in his convocation address when he said that, compared to lectures, which has an average memory rate of 5%, practice by doing (activity-oriented) learning has a retention rate of about 75%. It is evident that when teaching methods become more interactive and activity-based, the memory rate progressively increases (National Educational Research and Development Council, 2018).

It is a concept that interest educationists more importantly the gender-based differences in Biology. Due to their social or cultural context, many parents may not wish to invest as much on their daughters' education as they do on their sons, according to Adegboye (2018). Gender stereotypes in schools are impacted by this. Thus, research on the different effects of gender on Biology students' performance is necessary. Research on the performance of secondary school students biology by gender have shown mixed results; although some research (Ndirika and Ubani, 2017; Aniodoh, 2019) found that boys performed better; other research reports (Lorchugh, 2016; Afuwape and Oludipe, 2008) found no difference in performance between the sexes. These discrepancies possibly resulted from the fact that these investigations were carried out with students from various classes, (SS 1, SS 11, and SS 111), on various biological topics, and under various testing circumstances, including objective, essay, or practical. Additionally, the designs of these studies, whether experimental, quasi-experimental, or causal–comparative as well as the use of retention or immediate post-tests may have contributed to this situation. In order to establish a body of more reliable data on the impact of gender and cognitive styles on students' successes in biology, it is necessary for future studies to take these factors into account. This study therefore looked at how senior secondary

students' achievements in Biology are affected by Hands-on activity strategies. The study also looked at gender difference at two levels (male and female).

Hypotheses

1. There is no significant effect of Hands-on approach on students' achievement in Biology.
2. There is no significant effect of gender on students' achievement in Biology
3. There is no significant interaction effect of Hands-on approach and gender on students achievement in Biology

Methodology

The research adopted a non-equivalent pre-test, post-test, control group, quasi-experimental design using 2 x 2 factorial matrixes.

The layout of the design is shown below:

A	O_1	X_1	O_2
B	O_1		O_2

O_1, = Pre-test Observations of student achievement test in Biology

O_2, = Post-test Observations of student achievement test in Biology

X_1 = Hands-on approach (Experimental treatment)

Population

The population for this study consisted of all senior secondary school II students offering Biology from two (2) selected secondary schools in Obafemi-Owode Local Government Area, Ogun State.

Sample and Sampling techniques

The samples of the study consisted of fifty (50) students in the classes from two senior secondary school II offering Biology in co-educational senior secondary schools. The selected schools for the study were purposively picked among the senior secondary schools in Obafemi Owode Local Government Area. The two schools were assigned into experimental and control group respectively.

The researcher adopted a purposive sampling technique, and the schools were selected based on the following parameters:

Criteria for selection of school

a. The presence of well- equipped Biology laboratory
b. Trained and experienced Biology teacher
c. Schools must be mixed.
d. Readiness and willingness of the cooperating teachers of the schools to participate in the study.

Biology Achievement Test (BAT) was used for data collection and to determine the students' achievement in both pre-tests and post- tests**.** BAT was a researcher developed instrument that contains two sections (A and B). Section A contained bio data information on the personal data of the respondents with respect to gender and school while section B contained items questions to which respondents were expected to provide the correct answers. The BAT developed by the researchers was used to assess students' achievement in Biology. It covered four (4)

topics present in SS2 Biology curriculum to be treated (Table 2).

Table 2: Item Distribution of Biology Achievement

Topics	Level of cognitive domain			Total
	Knowledge	Comprehension	Application	
Excretory system	1	4	2	7
Supporting tissue and system	2	2	3	7
Vertebrae skeleton	4	3	2	9
Joint	3	2	2	7
Total	10	11	9	30

It consisted of questions from 4 topics. Out of one hundred (100) questions, thirty (30) questions were selected after going through discriminatory, difficulty and distraction index. The BAT was administered as a pre-test and post-test to both control and experimental groups to assess students' science achievement. The researcher preferred to use multiple choices as test questions due to ease of application and objectivity. The BAT instrument in this research was subjected to both content and face validity by the researchers' supervisor and other experts in the Department of Science and Technology Education (STED) in Faculty of Education of Olabisi Onabanjo University, Ago Iwoye. The supervisor also did some modifications on test items in the Biology Achievement Test to ensure that the questions and statements involved are relevant to areas of the study. The corrections and suggestions made by the experts were effected which led to improved instrument. The instrument was pilot tested using twenty Biology students who were not participants in the study. The reliability coefficient was determined using split half method for the achievement test. The result showed 0.64 indexes for BAT.

Procedure for data collection

The study made use of the following schedules for collection of data: A week was used to train research assistant on how to administer pre-test and conduct treatment for four weeks and one day for administration of post -test. Data collected were analyzed using frequency count and percentage while inferential statistics involved the use of analysis of covariate (ANCOVA) and multiple classification analysis. Hypotheses were at 0.05 level of significance.

RESULTS

Test of Hypotheses

Ho_1: There was no significant effect of Hands-on approach on students' achievement in Biology.

There was a main effect of treatment ($F_{(1, 47)} = 7.268$). This indicated that Hands-on strategy group and control group differed in scores obtained in post-test mean score in Biology achievement test after the treatment and the difference was significant (Table 3).

Hence, there was a significant effect of instructional strategy on students' achievement in Biology.

Table 3: Summary of Analysis of Covariance of Students Achievement in Biology based on Treatment and Gender
Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	56.936[a]	4	14.234	3.973	.008
Intercept	213.775	1	213.775	59.674	.000
Covariate	33.836	1	33.836	9.445	.004
Treatment	26.038	1	26.038	7.268	.010
Gender	1.272	1	1.272	.355	.554
Treatment * gender	.300	1	.300	.084	.774
Error	154.043	43	3.582		
Total	28681.000	48			
Corrected Total	210.979	47			

a. R Squared = .270 (Adjusted R Squared = .202)

The MCA showed a grand mean of 24.35; students in the control group (conventional method) recorded adjusted post-test mean achievement score of 23.666 while students taught with Hands-on strategy recorded adjusted post-test mean achievement score of 25.03. This outcome showed that students taught with Hands-on strategy recorded higher adjusted post-test mean achievement score in Biology (Table 4).

Table 4: Multiple Classification Analysis (MCA) of Students Post Test Mean Score in Biology according to Treatment
Grand Mean = 24.35

		N	Unadjusted	Eta	Deviation Adjusted for Factors	Beta Adjusted for Factors
Treatment	Hands On	24	.68750		.68379	
	Control	24	-.68750	.328	-.68379	.326

Ho_2: There was no significant main effect of gender on students' achievement in Biology

The analysis of covariance (Table 3) showed no significant main effect of gender on students achievement in Biology ($F_{(1, 47)} = .355$). This implies that the post-test mean achievement score of male and female students in Biology in the treatment and control group was not statistically different. Hence, the null hypothesis H_{02} was retained.

The result of MCA on gender (Table 5) showed a grand mean of 24.35; male students recorded adjusted post-test mean achievement score of 24.42 and female students recorded adjusted post-test mean achievement score of 24.242. This outcome is an indication that male students recorded higher post-test mean achievement score in Biology. However, the difference was not significant. Also, gender in the study as moderator variable contributed 4.2% to the variance in students' achievement in Biology.

Table 5: MCA of Students Post Test Mean Score in Biology according to Gender (Grand Mean = 24.35)

					Deviation	
				Eta	Beta	
		N	Unadjusted		Adjusted for Factors	Adjusted for Factors
Gender	Male	29	.09411		.07053	
	Female	19	-.14364	.055	-.10765	.042

Ho_3: There was no significant interaction effect of treatment and gender on students' achievement in Biology

In the 2-way interaction result (Table 3). There was no significant interaction effect of treatment and gender on students' achievement in Biology ($F_{(1, 47)} = .084$). This outcome implies that student's post-test mean achievement scores in Biology in the levels treatment (Hands-on and control) did not vary across the two levels of gender (male and female). Hence, null hypothesis was retained.

DISCUSSION

The result showed a significant effect of instructional strategy on students' achievement in Biology. This implies that the strategy led to improvement in students' academic achievement in Biology. This could be as result of the benefits attached to the use of Hands-on strategy, as a student-centered method. The usage of Hands-on activities results in more cooperative learning activities among the students as well as an encouragement for teachers and students to work together. According to Bolick, et al. (2018), some educators are enthralled by the poten-

tial of hands-on activities to improve teaching and learning, while other educators lag behind in including hands-on activities into their lesson plans. This confirms the report of Obiageli et al. (2020) where findings showed that students exposed to Biology material using a hands-on, mind-on approach outperformed those exposed to a lecture method. The finding also consolidates the report of Oludipe et al. (2020) which demonstrated that there were substantial disparities between the academic achievements of the students in Hands–on and Control group at both the post-test and delayed post-test levels.

The report also acknowledges the findings of Ekwueme et al. (2015) where the results of the study demonstrated that students' performance and involvement in mathematics and basic science activities had improved, and teachers' willingness to employ a Hands-on method to teach their students scientific and mathematical ideas had also increased. The result also found that gender was not significant on students' achievement in Biology. This could suggest that student gender will not be a major factor when teaching with Hands-on strategy. The result is thus related to Obiageli et al. (2020) whose findings showed that neither gender nor the combination between gender and teaching style had a significant impact on students' achievement in biology. Ogundola (2021) and Olarinoye (2015) revealed that female students performed better than male students in courses involving practical applications; likewise, studies carried out by Abdul-Raheem et al. (2017) and Ndirika and Ubani (2017) uphold neutrality in the difference in academic achievement between male and female students. In consequence, gender issue remains inconclusive and not a major factor when using hands-on strategy in teaching biology.

Major findings of the study

The study investigated the effects of Hands-on strategy on students' achievement. Previous studies have related with the effectiveness of Hand-on strategy ability to improve students' achievement in different subjects. The findings of this study suggested that incorporating hands-on activities positively influenced students' achievement in Biology by enhancing their understanding, comprehension, critical thinking skills, and overall interest in the subject.

Recommendations

Arising from the findings of this study. It was recommended that:

Teachers should be provided with adequate training and support to ensure they can effectively implement Hands-on activities in their teaching.

Professional development workshops, sharing best practices, and mentoring opportunities can help educators feel confident and competent in utilizing these techniques.

Collaborative and supportive learning environment should be fostered, where students are encouraged to explore, ask questions and learn from their mistakes to enhance the benefit of Hands-on learning experience in biology.

Encouraging peer-to-peer interactions, group work and discussions can further deepen students' understanding and retention of key concepts.

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