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UNRAVELLING THE TRANSFORMATIVE IMPACT OF LABORATORY PRACTICAL APPROACH ON STUDENTS' MANIPULATIVE SKILLS AND ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCIENCE

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Abstract:
This study delves into the transformative influence of the Laboratory Practical Approach on students' manipulative skills and academic achievement in senior secondary science. A non-randomised pre-test and post-test quasi-experimental research design were used. Three intact classes drawn from three co-educational senior secondary schools (SSS) involving a total of 98 SSS II students from Education District V, Lagos State participated in the study. Two research instruments: Students' Manipulative Skills Test (SMST) and Students' Academic Achievement Test (SAAT) with reliability indices of 0.80 and 0.79 respectively were used for data collection. Two intact classes (experimental groups) were engaged in the laboratory practical approach while one intact class (control group) received the lecture teaching method. Data obtained were analysed using mean, standard deviation, and one-way ANCOVA at 0.05 level of significance. Results revealed that

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students' manipulative skills and achievement in science were significantly higher in the laboratory practical group compared to those exposed to the lecture method [$F(1,91)=399.85$; $p<.05$] and [$F(1,91)=21.33$; $p<.05$] respectively. A statistically significant difference was not found for gender in manipulative skills [$F(1,61)=.94$; $p>.05$] and achievement [$F(1,61)=.24$; $p>.05$] of students in science. The study provides evidence that the laboratory practical approach is more beneficial for students' manipulative skills and academic achievement in science than the lecture teaching approach. It is therefore recommended that teachers should ensure that all science topics taught are supported with practical tasks for the students to relate the theoretical and practical aspects to enhance their manipulative skills development as well as improve their academic achievement.

Keywords: achievement, manipulative skills, laboratory practical approach, lecture method, science teaching

1. Introduction

The world population is growing fast resulting in global competition and technological transformation in all spheres of human life. To understand and cope with these challenges, knowledge of and about science is integral to preparing the populace. Science is a field that deals with the methodical study of the environment and helps people cultivate an inquiring mind, self-control, and logical thinking skills necessary for technological advancement in all areas of human existence (Ajayi & Ibukun, 2013). Science can also be conceived as a potent mode of thought that gives people the information, they need to comprehend their surroundings and the wider world. This is done in an effort to unlock people's potential and talents and change how a country's economy develops technologically (Alane & Scott, 2022).

Science is taught in senior secondary schools as biology, chemistry, and physics to provide learners the opportunity to develop critical thinking and problem-solving skills required for scientific literacy (European Commission, 2015; McFarlane, 2013). Scientific literacy, according to Hackling et al. (2001), is the ability to apply scientific information, recognize questions, and reach conclusions based on evidence in order to comprehend and assist in making decisions regarding the natural world and the alterations brought about by human activity. This essentially deals with methods of acquiring and applying information to address current societal issues.

In recent times, it has been found that despite the relevance of science to the scientific and technological advancement of the country, most students found science taught in schools not relevant, non-interesting, and bored to them (Ogunmade, 2006; Ogunmade & Saibu, 2017). This in essence culminated in students' underachievement in science subjects on an annual basis in external examinations conducted by West African Examination Council as reported by Chief Examiners (WAEC, 2018, 2019 & 2021). This ugly situation was further corroborated by Araoye (2013) who affirmed that students' performance in science subjects in external examination was poor and he associated it with the conventional didactic lecture method of teaching used mostly by teachers in science teaching with limited engagement of learners in practical activities.

According to the European Commission (2015), the lecture method is found to be a teacher-centered teaching approach where students are not given adequate room for active participation during the lesson but rather remain passive recipients of teacher instruction throughout the lesson. Literature has revealed that the lecture approach to teaching has a significant adverse effect on learners' ability to attain a minimum level of core skills necessary for creative and innovative ideas (Olatoye et al., 2013; Al-Abdali & Al-Balushi, 2016; Oginni & Saibu, 2019; Anderson, 2020). More so, Ezenwosu and Nworgu (2013) affirmed that in most science classrooms in Nigeria, teachers use predominantly lecture method of instruction to cover a large chunk of curriculum contents and a lot of topics in the shortest possible period of time and rarely engage learners in regular practical laboratory manipulative activities in science. Thus, the widespread use of the lecture technique may have an impact on learners' ability to acquire the minimal level of fundamental skills required for the development of creative and innovative talents that are essential in the twenty-first century, in addition to their cognitive abilities.

However, Okoro (2018), and Sorgo and Spernjak (2012) in their separate studies revealed that learners would develop the spirit of creativity only when teachers make use of appropriate teaching method(s) which emphasises '*learning by inquiry or doing*' as highlighted in Nigeria Policy on Education (Federal Government of Nigeria, 2014). It is important therefore that learning science should be inquiry and activity-based thereby affording learners to develop core manipulative skills in science. Particularly in higher-level sciences (such as biology, chemistry, and physics), manipulative skills are crucial to science education and can only be acquired via practical experience.

Opara (2011) noted that hands-on practical instructions provide learners with the opportunity to think critically to make mental representations of ideas in real-world situations and become innovative. In essence, the use of a practical instructional approach in the teaching and learning of science would benefit the students, teachers, parents, educators, and curriculum planners towards developing scientifically literate citizens required in today's world of work. It is based on this premise that Hackling et al. (2001) mentioned that the way teachers teach science to learners and how the learners learn science has an influence and implication for developing core manipulative skills and better academic achievement in the learners (Beaty, 2017).

2. The Problem

The predominant use of the lecture approach to teach science has continued to encourage knowledge transfer from the teacher to the students rather than meaningful learning experiences. The passivity of learners in the learning process discourages the development of core manipulative skills and the attainment of better academic achievement in science. To address this situation, therefore, there is the need for teachers to regularly expose learners to practical instructional approaches so as to encourage them to develop appropriate manipulative skills in science. It is based on this premise that this study comprehensively unravels the transformative impact of the laboratory practical approach on students' manipulative skills and academic achievement in senior secondary science to make appropriate recommendations for improving students' academic achievement in science learning.

Therefore, the study sought to answer the following research questions.

1) Is there a statistically significant difference between the science lecture method and the laboratory practical approach in terms of students' manipulating skills?
2) Does the academic achievement of students who receive scientific instruction via lecture and laboratory practical approaches differ statistically?
3) Is there a statistically significant difference between male and female students who are taught science through the laboratory practical approach and lecture method in terms of their academic achievement and manipulative skills?
4) Does gender and teaching strategies have any interaction effect on students' academic success in science and their manipulative skills?

2.1 Null Hypotheses

H0$_1$: There is no statistically significant difference in the students' manipulative skills when taught using the laboratory practical approach and lecture method in science.

H0$_2$: There is no statistically significant difference in the students' academic achievement when taught using the laboratory practical approach and lecture method in science.

H0$_3$: There is no statistically significant difference in the manipulative skills and academic achievement of male and female students taught using laboratory practical approach in science.

H0$_4$: There is no statistically significant interaction effect of methods of instruction and gender on manipulative skills and academic achievement of students in science.

3. Methodology

3.1 Research Design and Sample

A non-randomised pre-test and post-test quasi-experimental design were used in this study with all senior secondary school science students in Education District V, Lagos State as the study's population. In terms of functioning science laboratories and school location, three coeducational senior secondary schools were chosen using a purposive sample technique. Quasi-experiment design was conducted because random assignment was impossible. One intact class of senior secondary two (SS II) science (biology, chemistry, and physics) students from each of the three schools were used for the study. The participants were divided into two experimental groups and one control group such that the experimental groups had 65 students and the control group had 33 students (38 males and 60 females in all).

3.2 Research Instruments

This study made use of two main data collection instruments, namely: Students' Manipulative Skills Test (SMST) and Students' Academic Achievement Test (SAAT). The SMST was used to measure students' manipulative skills in handling of apparatus and equipment when carrying out various sciences practical laboratory tasks in selected topics in the areas of biology, chemistry, and physics. The overall score was rated based on four-point Likert rating scales: Excellent (4), Good (3), Average (2) and Poor (1).

The SAAT on the other hand provided a baseline from which individual student's competence in practical science achievement was exhibited in the form of scored marks. This was developed using questions three commonly used in senior secondary biology, chemistry, and physics textbooks. The items were constructed following the revised Bloom's taxonomy of the cognitive domain of educational objectives and were drawn on topics (biology: fruits and their classification and identification of plants and animal cells; chemistry: acid-base titration, and physics: speed and velocity) in SS 2 syllabi. The instrument contained 60 items with four options lettered A–D, the options for each question had one key and three distractors. The total possible score was 60.

In establishing the content validity of the two instruments, they were given to three experienced science teachers drawn from two senior secondary schools in Lagos State and two Science Education experts from the College of Sciences, Lagos State University of Education, Ijanikin, Lagos. A test-retest method was used to determine the reliability of the instruments, SMST and SAAT while correlated test scores of the two administrations of the test were determined with the Spearman-Brown formula which yielded a high-reliability index of 0.80 and 0.79 respectively and this warrants the usage of the instruments for the study.

3.3 Procedure for Data Collection

Three phases involving pre-intervention, intervention, and post-intervention phases were used for data gathering.

3.3.1 Phase 1: Pre-Intervention Phase

This phase involved the administration of a pre-test of the SMST and SAAT to all the sampled students to determine their manipulative skills and practical achievement before the treatment. This was done to ensure the similarity/homogeneity of the two groups before starting the intervention. The administration of the pre-test lasted for one week in each of the selected schools.

3.3.2 Phase 2: Intervention Phase

In the second phase which involved treatment, the participants in the experimental and control groups were taught the same science concepts in biology (fruits and their classification and identification of plants and animal cells), (acid-base titration) in chemistry, and (speed and velocity) in physics using laboratory practical instructional approach (the intervention) and lecture method. This was implemented with the aid of Instructional Guides (Instructional Guide on Laboratory Practical Instructional Approach and Instructional Guide on Lecture Method) which contained six lesson plans respectively on the topics taught for a period of six weeks in the laboratory.

3.3.3 Phase 3: Post-Intervention Phase

After six weeks of teaching, the reshuffled version of the same instruments used as pre-tests (SMST and SAAT) were administered by the researchers to the students in experimental and control groups as post-tests.

3.4 Data Analysis and Results

Descriptive and inferential statistics were applied to analyse the gathered data using the Statistical Package for Social Sciences (SPSS) version 23.0. The research questions were answered using percentage, mean, and standard deviation while the null hypotheses were tested with one-way analysis of covariance (ANCOVA) at a 0.05 level of significance.

Research Question 1: Is there a statistically significant difference between the science lecture method and the laboratory practical approach in terms of students' manipulating skills?

Table 1: Mean and Standard Deviation of the effect of treatments on senior secondary students' manipulative skills in science (N=98)

Groups	**N**	**Mean**	**SD**
Experimental	65	38.16	1.29
Control	33	23.41	1.40
Total	98	33.86	6.95

Table 1 shows the post-test mean and standard deviation of manipulative skills of students taught using laboratory practical and lecture method in science. The mean and standard deviation of the experimental group is M = 38.16 and SD = 1.29 while that of the control group is M = 23.41 and SD = 1.40. This implies that students taught using laboratory practical had better manipulative skills better than those taught using lecture method in science practical. Null hypothesis 1 was examined in order to assess the significance of the observed effect.

$H0_1$: There is no statistically significant difference in the students' manipulative skills when taught using the laboratory practical approach and lecture method in science.

Table 2: ANCOVA showing the difference in the students' manipulative skills when taught using the laboratory practical approach and lecture method in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4565.952[a]	6	760.992	558.254	.000	.974
Intercept	193.809	1	193.809	142.176	.000	.610
Group	1090.131	2	545.066	399.853	.000	.898
Error	124.048	91	1.363			
a. R Squared = .974 (Adjusted R Squared = .972)						

The univariate F-value associated with the post-manipulative skills test as indicated in Table 2 reveals that the laboratory practical instruction has a statistically significant effect on students' manipulative skills in science [$F(1,91)=399.85$; $p<.05$]. The R-squared shows that the independent variable accounted for 97.4% of the variation in students' manipulative skills in science. The partial eta squared estimate indicates that the treatments accounted for 89.8% of the variance observed in the post-test on students' manipulative skills in science. The implication of this is that the students in the experimental group improved their manipulative skills in science practical than their counterparts in the lecture method group after treatment. Therefore, the null hypothesis which states that there is no statistically significant difference in the students' manipulative skills when taught using the laboratory practical approach and lecture method in science is rejected.

Research Question 2: Does the academic achievement of students who receive scientific instruction via lecture and laboratory practical approaches differ statistically?

Table 3: Mean and SD of the effect of treatment on senior secondary students' academic achievement in science (N=98)

Groups	N	Mean	SD
Experimental	65	36.86	2.23
Control	33	29.45	3.70
Total	98	34.76	4.46

Table 3 shows the mean and standard deviation of students' post-learning achievement when taught using the laboratory practical approach and lecture method in science. The mean and standard deviation of the experimental group are M = 36.86 and SD = 2.23 respectively while that of the control group is M = 29.45 and SD = 3.70 respectively. This implies that the students taught using the laboratory practical approach performed better than those taught using the lecture method. To determine whether the observed effect was significant, null hypothesis 2 was tested.

$H0_2$: There is no statistically significant difference in the students' academic achievement when taught using the laboratory practical approach and lecture method in basic science.

Table 4: ANCOVA showing the difference in the students' academic achievement when taught using the laboratory practical approach and lecture method in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1240.813[a]	6	206.802	27.222	.000	.642
Intercept	1561.336	1	1561.336	205.525	.000	.693
Group	324.063	2	162.031	21.329	.000	.319
Error	691.309	91	7.597			
a. R Squared = .642 (Adjusted R Squared = .619)						

The univariate F-value associated with the post-academic achievement test as indicated in Table 4 reveals that the laboratory practical approach has a statistically significant effect on students' academic achievement in science [F(1,91)=21.33; p<.05]. The R-squared shows that the independent variable accounted for 97.4% of the variation in students' manipulative skills in science. The partial eta squared estimate indicates that the treatments accounted for 89.8% of the variance observed in the post-test on students' academic achievement in science. The implication of this is that the students in the experimental group improved their academic achievement in science than their counterparts in the lecture method group after treatment. Therefore, the null hypothesis which states that there is no statistically significant difference in the students' academic achievement when taught using the laboratory practical approach and lecture method in science is rejected.

Research Question 3: Is there a statistically significant difference between male and female students who are taught science through the laboratory practical approach and lecture method in terms of their manipulative skills and academic achievement?

Table 5: Mean and SD of the difference in manipulative skills of male and female students taught using the laboratory practical approach in science (N=98)

Gender	Group	N	Mean	SD
Male	Experimental	25	38.20	1.05
	Control	13	23.78	1.79
	Total	38	35.24	4.01
Female	Experimental	40	38.16	1.50
	Control	20	23.25	1.21
	Total	60	30.71	4.81

Table 5 shows that the post-test mean and SD of manipulative skills test scores of male students in the experimental group are 38.20 and 1.05 and that of the control group are 23.78 and 1.79. However, the female students in the experimental group are 38.16 and 1.50 and that of the control group are 23.25 and 1.21 respectively. The result indicates that the mean and SD of male students' manipulative skills scores are marginally higher than the female students after the treatment. To determine whether the observed effect was significant, null hypothesis 3 was tested.

Table 6: Mean and SD of the difference in the academic achievement of male and female students taught using laboratory practical approach and lecture method in science (N=98)

Gender	Group	N	Mean	S. D
Male	Experimental	25	36.80	2.32
	Control	13	28.89	2.67
	Total	38	32.85	4.01
Female	Experimental	40	36.87	2.08
	Control	20	29.70	4.12
	Total	60	33.29	4.82

Table 6 demonstrates that the post-test mean and SD academic achievement scores of male students in the experimental and control groups are 36.80 and 2.32, and 28.89 and 2.67 respectively while those of the female students are 36.87 and 2.08, and 33.29 and 4.82 respectively. This suggests that the mean and SD of male students' academic achievement are slightly lower than those of female students after the treatment. Null hypothesis 3 was tested in order to ascertain whether the observed effect was significant.

H0$_{3}$: There is no statistically significant difference in the manipulative skills and academic achievement of male and female students taught using laboratory practical approach in science.

Table 7: ANCOVA showing manipulative skills of male and female students taught using laboratory practical approach in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4565.952[a]	6	760.992	558.254	.000	.974
Intercept	193.809	1	193.809	142.176	.000	.610
Gender	1.275	1	1.275	.935	.336	.010
Error	124.048	61	1.363			
a. R Squared = .974 (Adjusted R Squared = .972)						

The univariate F-value linked with the post-manipulative skills test in Table 7, gender had no statistically significant impact on students' manipulative skills in the laboratory practical approach [F(1,61)=.94; p>.05]. According to the partial eta squared estimate, the treatment was responsible for 0.01% of the variation seen in the post-test of the students' practical manipulative skills. This suggests that there is no interceptive effect of laboratory practical on gender differences in students' manipulating abilities.

Table 8: ANCOVA showing academic achievement of male and female students taught using laboratory practical approach in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1240.813[a]	6	206.802	27.222	.000	.642
Intercept	1561.336	1	1561.336	205.525	.000	.693
Gender	1.848	1	1.848	.243	.623	.003
Error	691.309	61	7.597			
a. R Squared = .642 (Adjusted R Squared = .619)						

The univariate F-value associated with the post-academic achievement test in Table 8 depicts no statistically significant correlation between gender and students' academic success in science [F(1,61)=.24; p>.05]. According to the partial eta squared estimate, the treatment was responsible for 0.03% of the variation seen in the post-test results regarding the academic performance of the students in science. This suggests that there is no discernible effect of using the laboratory practical approach on gender differences in students' academic achievement in science. As a result, the null hypothesis, which states that there is no statistically significant difference between male and female students taught using laboratory practical method in terms of their manipulative skills and academic achievement, is not rejected.

H0₄: There is no statistically significant interaction effect of methods of instruction and gender on manipulative skills and academic achievement of students in science.

Table 9: ANCOVA showing interaction effect of methods of instruction and gender on manipulative skills of students in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4565.952[a]	6	760.992	558.254	.000	.974
Intercept	193.809	1	193.809	142.176	.000	.610
Group * Gender	1.778	2	.889	.652	.523	.014
Error	124.048	91	1.363			
a. R Squared = .974 (Adjusted R Squared = .972)						

Table 9 reveals no statistically significant interaction effect of methods of instruction and gender on the manipulative skills of students in science practical [F(1,91)=.65; p>.05]. The partial eta square which is 0.14 also shows no interaction effect. This result suggests that students' manipulating skills are not influenced by their gender when science is taught via the laboratory practical approach.

Table 10: ANCOVA showing interaction effect of methods of instruction and gender on academic achievement of students in science

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1240.813[a]	6	206.802	27.222	.000	.642
Intercept	1561.336	1	1561.336	205.525	.000	.693
Gender * Group	12.664	2	6.332	.833	.438	.018
Error	691.309	91	7.597			
a. R Squared = .642 (Adjusted R Squared = .619)						

Table 10 shows no statistically significant interaction effect of methods of instruction and gender on the academic achievements of students in science [F(1,91)=.44 ; p>.05]. The partial eta square which is 0.18 also shows no interaction effect. This result depicts that if students are taught science using the laboratory practical approach, their learning outcomes will not be affected by their gender. As a result, the null hypothesis, which claims that gender and teaching strategies have no statistically significant interaction effect on students' manipulative skills and academic achievement in science, is not rejected.

4. Discussion of Findings

This study examined the transformative impact of laboratory practical approach on students' manipulative skills and academic achievement in science. Findings from hypotheses one and two indicated there is a statistically significant difference in students' manipulative skills and achievement when they are taught using the laboratory practical approach and lecture method in science. This in essence means that practical approach enhances learners' interest and learning outcomes when they are made to engage in useful activities. The findings are directly in line with Ntawuhiganayo and Nsanganwimana's (2022) finding on the effects of laboratory practical activities on learners' academic achievement and attitude towards biology in selected secondary schools in Rwanda which revealed that, the experimental group taught under laboratory practical activities achieved higher mean-scores than control group taught using teacher-centered activities, the "chalk and talk method". Similarly, Antwi, et al. (2021) findings indicated that the students' academic performance was enhanced when taught using practical work on physics learning as they acquired important scientific process skills needed for science practical work and developed positive attitudes towards science practical work.

In addition, Sshana and Abulibdeh's (2020) study on science practical work and its impact on students' science achievement found that mean score comparison revealed a significant difference in the attainment scores of the experimental over the control groups in science. Issah et al. (2023) found that pupils are far more engaged while interacting with teaching and learning materials than when they are not in science. Ihejiamaizu et al. (2020) who investigated the effect of biology practical activities on the performance of secondary school students in Cross River State, Nigeria corroborated that there was a significant effect of biology practical on the academic performance of students.

Also, in consonant with the finding of this study is Twahirwa and Twizeyimana (2020) study on the effect of practical work on academic performance in physics among learners at the selected secondary schools in Rwanda, which revealed that practical work is more effective in improving students' performance. Kambaila et al. (2019) in their study in Zambia found out that practical activities positively improve students' performance in biology more than the traditional teaching method. Furthermore, Elias (2017) reported that students who were taught genetics via a hands-on approach outperformed those taught the same concept under the conventional teaching method.

Fadzil and Saat (2017) in their study on exploring students' acquisition of manipulative skills during science practical work emphasized that manipulative skills play an important role in students' ability to complete science activities effectively. To acquire experience in manipulating specific scientific apparatus, students need to perform various experiments using the apparatus. The findings of this study are also in the same line with those of Olutola (2016) who investigated the effect of practical and alternative to practical method on students' academic achievement in biology and found that practical method has a significant effect on secondary students' performance in biology. Moedas (2015) affirmed that science subjects cannot be taught effectively to learners in the absence of engaging in practical activities because exposing learners to hands-on and minds-on instructional approaches would contribute significantly to promoting learners' creativity and innovation in science.

This result also supports John's (2016) research, which found that using practical method to teach and study chemistry at the secondary school level enhanced students' performance. Kadala (2014) provided more evidence to support the claim that the project-based learning pack's investigative processes help students build important academic knowledge, practical skills, the capacity to solve problems in real-world scenarios, and motivation as they collaborate as a team. Similarly, Mwangi (2016) affirmed that a majority of students agreed that the use of chemistry practical makes learning to be enjoyable for them and increases their understanding of concepts. In addition, it was observed that pressure to cover the syllabus is not an obstacle to using chemistry practical as a teaching and learning method.

Also, findings from hypotheses three and four revealed no statistically significant difference in the manipulative skills and academic achievement of male and female students taught using laboratory practical in science. This may be due to the same level of interest and enthusiastic nature involved in practical activities shown by male students and their female counterparts. The finding was not particular because it is similar to the previous study by Ajayi and Ogbeba's (2017), which looked at the effect of gender on students' achievement in stoichiometry using hands-on activities and found no statistically significant difference in the mean achievement scores between male and female students who were taught stoichiometry using hands-on activities. More so, some researchers Oludipe (2012), and Ogunkola and Bilesanmi-Awoderu (2000) found no significant differences in male and female students' achievement in science when exposed to both lecture and laboratory practical. It could therefore be deduced that students' manipulative skills and achievement in science were not sensitive to their gender.

At variant with the findings of this study, Abidoye (2021) revealed that the impact of laboratory practical was significant based on gender as the result indicated that laboratory practical has a higher influence on the performance of male students whose mean value is greater than that of the female. Shana and Abulibdeh (2020) also reported that male students achieved significantly better than female students in science due to male masculine nature in handling laboratory apparatus and their interest in engaging in practical activities. Additionally, Musasi et al. (2012) study identified practical work as an influencing agent in the process of learning of girls in physics. By enabling the girls to carry out practical investigations, theoretical implications are clarified.

6. Conclusion and Recommendations

The researchers concluded that the utilisation of the laboratory practical approach improves students' manipulative skills and achievement in science as a result of their involvement in the learning tasks when compared with the lecture approach which emphasises rote learning and regurgitation of scientific facts, principles, and generalizations.

The study findings however revealed no gender disparity in science achievement when students engage in laboratory practical activities. This implies therefore that laboratory practical is rewarding to students in terms of achievement regardless of their gender and could be a means of narrowing the gender gap in achievement in science among students. This requires therefore that key stakeholders in science education including science teachers, school principals, and examination bodies should intensify their efforts towards ensuring that this becomes a reality.

Based on the research findings highlighted above, the study recommended that:

1) The government should provide more laboratory equipment/materials needed for regular practical work for the students and ensure that the equipment and materials are relevant and adequate to meet the increasing population of students in schools.
2) There should be inclusion of outdoor practical activities such as field trips or excursions or industrial visits in the secondary school science curriculum for students to link their studies with daily experiences in their immediate community.
3) The school timetable should provide an extra period for laboratory practical in science and this practical period should be excluded from the normal classroom teaching period.
4) Teachers should ensure that all science topics taught are supported with one or two practical tasks for the students to relate both the theoretical and practical

aspects of the topic(s) in order to enhance their understanding of the topic and as well improve their academic achievement in science.

Conflict of Interest Statement

The authors declare no potential conflicts of interest concerning this research.

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