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EFFECTS OF ENHANCED INQUIRY AND 5ESMODEL INSTRUCTIONAL STRATEGIES ON STUDENTS' ACHIEVEMENT IN SENIOR SECONDARY SCHOOL BIOLOGY

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Abstract

Biology is a requirement for further learning, training, and development for many sciences related professional courses. Despite its importance, students' performance in Senior School Examinations is poor/ inconsistent. Thus, this study investigated the effect of enhanced inquiry and 5esmodel instructional strategies on students' achievement in Biology. The study adopted the quasi-experimental pre-test, post-test nonequivalent control group research design and was carried out in two educational districts in Lagos State. The instrument used for data collection was the Biology achievement test. Data collected was analyzed using mean and Analysis of Covariance. Results indicated that enhanced inquiry instructional strategy had the most significant effect on students' achievement while there was no significant gender preference on students' achievement in Biology. Mental ability had significant effect on students' achievement in Biology. It can therefore be deduced that enhanced inquiry is effective and inspiring. It could substitute lecture method and enhance students' achievement. In addition, gender is not a determinant of students' achievement in biology classes. Recommendations included that teacher should adopt enhanced inquiry instructional strategy. Teacher educators should be professionally trained on the use of enhanced inquiry so that teachers- in training in turn become aware of the strategy before graduation from school. The teachers should ensure that during group discussion essential values such as not ignoring other students' ideas are upheld amongst others.

Introduction

Biology involves all the physiochemical areas of life (Britannica.com). It deals with the study of living things and their important processes. Biology deals with life and the living. The importance of Biology cannot be undermined as it is a scientific path to know life (biologyonline.com). It describes the alterations of the human bodies. Therefore, anyone who studies it will know the cause of alterations taking place in their bodies. Also, it shapes various careers such as medicine, engineering, teaching, nursing etc. It also gives way for scientific investigation which in turn allows the discovery of emerging issues by scientific method. Despite the importance of biology, the statistics of performance in biology released by WAEC shows that students' performance is poor/inconsistent as shown in table 1 below.

Table 1: Candidates Performance in May/June Senior Certificate Examination in Biology in Nigeria from 2007 – 2018

Year	Total Sat	Credit Passes	%
2007	1,238,163	413,211	33.37
2008	1,259,964	427,644	33.94
2009	1,903,552	644,733	33.87
2010	1,300,418	427,644	33.90
2011	1,505,199	579,443	38.50
2012	1,646,150	587,044	35.66
2013	1,648,363	854,743	51.73
2014	1,365,384	766,971	56.17
2015	1,390,234	798,246	57.42
2016	1,200,367	740,345	61.68
2017	1,544,334	923,486	59.21
2018	1,572,396	786,016	49.99

Source: The West African Examination Council

Considering year 2007-2012, the performance is below average of 50%. Although there was an increase in performance from 2013-2016, 2017 &2018 witnessed decrease in performance, this shows that the performance is inconsistent. Researchers have found that instructional strategy could affect students' performance and different instructional strategies have been used in teaching Biology. In addition, despite all the instructional strategies that have been used in teaching Biology, the performance of students in WASSCE Biology needs to improve. Therefore, different instructional strategies have been compared by researchers among whom are Abdullahi and Duyilemi (2013) ,Shamsuddeen & Amina (2016) , Amusa (2016), Oladipo(2016) , Ogundiwin & Oladipo (2018). Despite the comparison, the performance is still inconsistent. Jeromes , Palmberg & Yli-Panula (2016) however emphasized that instructional strategies are context & subject depended. So, it cannot be arranged in order of least effective or most efficacious. Therefore, the quest for suitable strategies for different concepts in Biology is expedient. Therefore, this study involves the use of enhanced inquiry strategy and 5Es instructional model. The selected concepts studied were feeding and transport. Enhanced inquiry as used in this study involves the integration of 5Es instructional model with inquiry.

The 5Es Instructional Model

The 5Es model is a teaching procedure that is line with the inquiry nature of science. The 5Es Instructional Model is built on constructivist-learning theory. It appears in Figure 1 below and comprises of *engage*, *explore*, *explain*, *elaborate*, and *evaluate* phases as shown below. Bybee (1997) emphasized that it could help students to reorganize and replace their preliminary concepts via self-reflection.

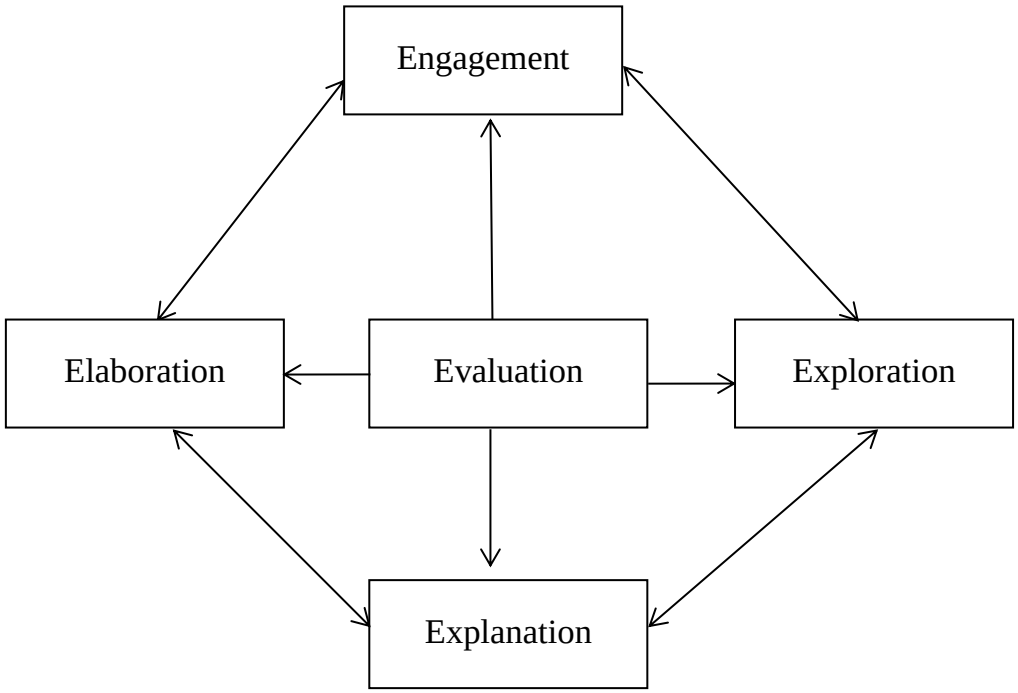

Figure 1: The 5Es Instructional Model

Engagement

This is the first phase of the cycle where the teacher appraises student prior knowledge. It is student centered. This phase supposed to be an inducing time which will generate a desire to know further about the topic to be taught. Students might ask themselves questions about the topic... A know, what, learned (KWL) chart can also be used.

Exploration

It comes after the engagement phase and is also student-centered. It embeds active exploration. Students are involved in perceiving, searching, investigating, and hypothesizing. They also discuss with their peers; some skills and concepts get evolved in the process. The teacher just acts as a facilitator or consultant. They are given hand –on experience before any concept or definition is explained by the teacher.

Explanation

This phase is the next one after exploration. It allows students to describe their understanding and pose questions as regards the concepts explored. New questions can come up during this phase. The students give their own explanation before the teacher that serves as facilitator. The teacher also explains and clarifies students' misconceptions that might have occurred during the exploration phase. The teacher gives formal definition and notes.

Elaboration

Application of new knowledge is done by students at this phase and new skills are reinforced. They are also to create new models because of the new skills gotten. The aim of this phase is to allow students have in depth knowledge of the concepts taught. Application of students' knowledge to other disciplines can be done. The activities carried out here can also involve the integration of technology.

Evaluation

Formal and informal forms of assessment are utilized here. Students can self-assess, or peer assess themselves. Assessment here is different from what is obtainable in lecture method. It is an on-going process as teachers observe students and see how they are applying the new skills and try to search for evidence that indicates that their thinking has changed. The evaluation could also be a summative one for example writing of examination.

Enhanced Inquiry

As used in this study, the enhanced inquiry involves the integration of 5Es with inquiry. Inquiry here involves the use of the following:

Use of Pictures and Materials

A photograph is worth a thousand words through which a complex idea can be conveyed with just a single still image. Pictures allow for quick absorption of great amounts of data. Using photographs for explaining complex phenomena is one of the teaching aids of modern education system all over the world. Alenizi (2015) worked on the use of photography to support the learning process of science teachers and found that visual media such as images and photographs allow students to comprehend some concepts of science subjects, precisely biology, physics, and chemistry. He, therefore, advocated for the inclusion of visual media in the curriculum. Krauss, Salame, and Goodwyn (2010) asserted "if a picture is worth a thousand words, think about how long it takes your students to read a thousand words" this implies that a picture speaks volume therefore it can help in saving time during teaching and learning process. They also opined that photographic case studies can simply be used to teach various science subjects and pointed out that they have used them most widely in the field of biology. Quillin & Thomas (2015) asserted that it is challenging to envisage teaching, learning, or doing biology devoid of the use of visual representations. They emphasized that as in other STEM disciplines, the three-dimensional and time-based dimensions of biology span many orders of enormousness and involve difficulty that dares the confines of human understanding. Visual representations are potent tools, because they help to make the unnoticed seen and the difficult simple.

Reflection and Students Personal Journal

Reflection involves considering, examining, and thinking about the content of the lesson. Students' personal journal refers to a place for personal ideas, where students record their thoughts, actions, and outcomes in the process of building their knowledge. Eduardo, Valeria, Francisco & Elias (2021) found in their study that through reflective practice by teachers' tacit knowledge can be changed to explicit knowledge. Awodun (2020) in his study on reflective teaching strategy found that the students taught using this strategy produced better achievement. Scharmann, & Butler, (2015) in their study found that students journaling helps in assessing their learning and it assisted students to shift from the level of not informed to being informed. Al-Rawahi& Al-Balushi (2015) discovered in their study that students reflective journal writing allows better performance in their self-regulated learning strategies.

Class Project and Small Group Discussion

Project based learning is a student-centered pedagogy that entails a changing classroom approach. According to Thomas Markham (2011) project-based learning integrates knowing and doing. Students learn knowledge and elements of the core-curriculum, but also apply what they know to solve authentic problems and produce results that matter. Project based learning focuses education on the students, not the curriculum a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. Hugerat (2016) worked on project-based learning strategies and how it affects the classroom learning environment. He discovered that students who learnt science by project-based learning strategies observed their learning environment as being enjoyable with more teacher supportiveness and teacher-student interactions as expressively more progressive. Haatainen, Outi & Aksela, Maija. (2021) worked on project-based learning in integrated science education and discovered that teachers found PBL has been beneficial but there is need for support in other to implement it.

Small group discussions innovate thoughts and find solutions to problems. A small group is an operational method used by different schools with anticipated learning results Meo (2013). There is no set number for an ideal small group. We usually define a small group as 8–12 learners facilitated by a teacher. It is a student-centered method where all students connect with each other in an unrestricted discussion on a specific topic and participate in dynamic learning. A well-planned small group learning happening generate a dynamic and harmless learning atmosphere with useful chances for interaction among peers. It stimulates interrelated worldview, relations among disciplines and presents an extended opinion of subject matter (Kingston, 2018) Agnihotri & Ngorosha(2018). Roshni & Rahim (2020) studied the use small group discussion in teaching family medicine and found out that SGD is a more effective instructional tool in refining the attention span of students, understanding the principles of family medicine, and recall.

Anammalia, Manivel & Palanisamy (2015) worked on a research titled "Small group discussion: Students perspectives" and found that small group discussion was collaborating, pleasant, and bridged the gap between the teacher and student. The student's communication abilities were also enhanced.

Hugerat (2016) worked on project-based learning strategies and how it affects the classroom learning environment. He discovered that students who learnt science by project-based learning strategies observed their learning environment as being enjoyable with more teacher supportiveness and teacher-student interactions as expressively more progressive.

In addition, students' achievement is a dependent variable in this study. Students' academic achievement is the extent to which students attained their short or long-term educational goals. Extensive research has proven the efficacy of instruction in student achievement. This implies that instructional strategy plays an essential role in determining student achievement. Oyovwi (2019) therefore examined how students' achievement in biology can be enhanced and found that self-regulated learning strategy contributed immensely to students' achievement in Biology. However, Adewale, Nzewuihe & Ogunshola (2016) studied the factors that can affect students' achievement in Biology and found that the factors include teacher factors, students' factor, parent factor and school factor. Ahmed, Shittu,Yahaya, Dada(2019) investigated the effect of concept mapping instructional strategy on students achievement in biology and found that the strategy significantly affect students' achievement positively

According to Adesina (2015), gender is a factor that affects students' academic performance more importantly in science subjects, over the years with disparities in results while Olasehinde & Olatoye (2014) found that there was no significant difference in achievements between male and female students in their different subjects in science. In Nigeria, it is a general acceptance that males are leading when compared with female students. (Adigun, Onuhunwa Inunokhai, Soda and Adesina, 2015). However, educational statistics and worldwide media showed a distinct gender difference in academic achievement between male students and their female counterparts with girls being ahead of boys. (Van Zanden & Parker, 2018).

Furthermore, mental ability as used in this study is a moderator variable. Free dictionary defines mental ability as the ability to learn. It is an innate ability that is influenced by both heredity and environment. It involves the ability to think rationally, to observe the inner relationships among different situations. Mental ability includes higher mental like reasoning, problem solving and creative thinking. Vock, Preckel and Holing (2011) processes relationship between mental abilities and school achievement adopting path analysis design determined found that mental speed has significant effect on academic achievement. Sangodoyin (2011) Sand discovered that students' mental ability has significant effect on their achievement in Biology with students of high mental ability level being ahead of their counter parts. Olagunju, Duyilemi and Adesina (2013) found that mental ability significantly predicted the pre-service teachers' knowledge of agricultural economics.

Statement of the Problem

It has been discovered that the performance of students in WASSCE Biology is poor/inconsistent. This poor/inconsistent performance can hinder their dreams of studying professional courses like Medicine and pharmacy. WAEC Chief Examiners report also showed students inability to answer questions that fall under some concepts properly. The concepts include genetics, ecology, transport and feeding. As a result of this, researchers& educators have been working assiduously to alleviate this problem. They discovered that instructional strategy plays a major role in determining students' achievement. Therefore, different instructional strategies have been compared and their effectiveness researched extensively. Despite the comparison, the performance is still inconsistent. Jeromes, Palmberg & Yli-Panula (2016) however emphasized that instructional strategies are context & subject depended. So, it cannot be arranged in order of least effective or most efficacious. Therefore, the quest for suitable strategies for different concepts in Biology is expedient. As a result of this, the present study focused on feeding and transport as selected concepts in Biology. It is in view of this that this research work emerges and 5Es model is integrated into inquiry to form enhanced inquiry and to determine its effects on students' achievement in Biology. Mental ability and gender were used as moderator variables.

Research Hypotheses

The following hypotheses were postulated and tested at 0.05% level of significance in the study

H_{o1}: There is no significant main effect of enhanced inquiry and 5Es model on students' achievement in Biology.

H_{o2}: There is no significant main effect of gender on students' achievement in Biology.

H_{o3}: There is no significant main effect of mental ability on students' achievement in Biology.

Research Methodology

The research design used in this study was the pretest, posttest nonequivalent control group, quasi experimental design. The study matched the independent and moderator variables using the 3x2x3 factorial design. The independent variable for the quasi-experimental design is treatment/ instructional strategy operating at 3 levels: The 5Es strategy, enhanced inquiry strategy and conventional strategy.

All the biology students that are in SS2 in the Senior Secondary are the target population. Six public co-educational secondary schools were used for the study. SS2 Biology students in the schools were used for the study. The class was used because SS2 syllabus contains the topics to be treated and the students are not writing WAEC, NECO and JAMB to avoid interference with the study. Gender effect was examined therefore, the six schools are co-educational.

The sampling technique used for selecting the samples of the study was multistage. The two stages of multistage sampling technique used to select the samples are as stated below:

Stage 1: Two educational districts out of the six districts in Lagos State were selected through random sampling technique.

Stage 2: Six co-educational schools out of the two educational districts were selected through stratified random sampling. Teachers' qualification, local governments, co-educational schools, and districts were the strata used. Three schools were selected from each educational district totaling six schools that were utilized for the study. Two schools were selected for each of the two experimental groups and the control group. It implies that the three groups utilized two schools each. The total number of students and teachers involved in the study were 345 and six respectively.

The pretreatment was administered for one week and it involved the administration of Biology achievement test and mental ability test to both the experimental and control groups. The use of treatment was implemented over a period of 7 weeks to SS 2 Biology Students in the two treatment groups while the control group was exposed to lecture method. Biology achievement test was also given to each student after the intervention period to determine the effect of each strategy on their achievement in class. The data collected using these instruments was therefore analyzed using descriptive and inferential statistics. The descriptive statistics used was mean. ANCOVA was the inferential statistics used for testing the hypotheses which was rejected at a probability value less than or equal to 5% alpha level.

Result

Ho_1: There is no significant main effect of enhanced inquiry and 5Es model on students' achievement in Biology.

The results in Table 2 revealed that there is a significant main effect of treatment on students' achievement in Biology after controlling for the effect of pre test scores $F_{(3,375)}= 36.04$, $p=0.000$ ($p<0.05$)Hence, there is significant main effect of treatment on students' achievement in Biology .This means that there is a significant difference in the post test Biology achievement scores of students exposed to treatment (5es and enhanced inquiry) and those exposed to the lecture method. Therefore, hypothesis 1 is rejected. The most significant treatment effect is determined using parameter estimation.

Table 2

Summary of Analysis of Covariance (ANCOVA) of Achievement by Treatment, Gender and Mental Ability

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	36718.253	24	1529.927	9.261	.000	.372
Intercept	69954.387	1	69954.387	423.431	.000	.530
Pre-Achievement	110.905	1	110.905	.671	.413	.002
Treatment	17859.760	3	5953.253	36.035	.000	.224
Gender	95.710	1	95.710	.579	.447	.002
Mental ability	2695.760	2	1347.880	5.563	.004	.042
Treatment * Gender	1164.179	3	388.060	2.349	.072	.018
Treatment * Mental ability	75.615	6	12.603	2.561	.019	.001

Gender * Mental ability	118.666	2	59.333	.359	.699	.002
Treatment * Gender * Mental ability	2061.985	6	343.664	2.080	.055	.037
Error	61953.185	375	165.208			
Total	906423.000	400				
Corrected Total	98671.438	399				

Table 3

Parameter Estimates of Treatments for Achievement

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	36.441	2.101	17.341	.000	32.310	40.573	.432
Pre Achievement	-.170	.142	-1.202	.230	-.449	.108	.004
5Es	10.108	1.675	6.035	.000*	6.816	13.401	.084
Enhanced Inquiry	22.984	1.688	12.435	.000*	17.666	24.302	.281
Control	0[a]	.	.	.	.	.	.

a. This parameter is set to zero because it is redundant (Control). Dependent Variable: Post Achievement.

* Main effect is significant at 5% level.

The parameter estimates results revealed that enhanced inquiry has the most significant main effect on students' achievement at t = 12.435 ($p<0.05$), followed by 5Es at t = 6.035 ($p<0.05$). Further, enhanced inquiry and 5Es treatment methods are 0.281 (28.1%) and 0.084 (8.4%) times more likely to increase students' performance than lecture method (control) respectively. Also, a unit increase in enhanced inquiry and 5Es will increase students' achievement by 22.98 and 10.108 respectively. The results are further supported using pair wise comparison of main effects (post-hoc analysis).

Table 4

Post-Hoc Tests: Pairwise Comparisons of Means for Achievement

Dependent Variable: Post Achievement

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
5Es	Enhanced Inquiry	-11.499*	2.287	.000	-17.562	-5.435
	Control	10.108*	1.675	.000	5.667	14.549
Enhanced Inquiry	5Es	11.499*	2.287	.000	5.435	17.562
	Control	21.607*	2.195	.000	15.788	27.426
Control	5Es	-10.108*	1.675	.000	-14.549	-5.667
	Enhanced Inquiry	-21.607*	2.195	.000	-27.426	-15.788

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

The pairwise comparison results indicated that enhanced inquiry is the most effective teaching method which significantly influences students' achievement (performance), since there is significance mean difference compared to other teaching methods. 5Es teaching method is more effective than lecture method (control) in terms of achievement.

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

The test for significant main effect of gender on students' achievement in Biology is determined using analysis of covariance (ANCOVA). The summary of ANCOVA from table 2 results indicated that after controlling for the effect of pretest scores of students, gender had no significant main effect on students' achievement in Biology $F_{(1,375)} = 0.58$, $p = 0.5 (p > 0.05)$ Therefore, hypothesis 2 is accepted. Hence, there is no significant main effect of gender on students' achievement in Biology. Consequently, there is no gender preference on students' achievement in Biology.

Ho_3: There is no significant main effect of mental ability on students' achievement in Biology

The test for significant main effect of mental ability of students on achievement in Biology is determined using analysis of covariance (ANCOVA). The summary of ANCOVA results as shown in Table 2 indicated that mental ability has significant main effect on students' achievement in Biology $F_{(2,396)} = 5.56, p = 0.004 (p < 0.05)$. Therefore, the hypothesis is rejected. Hence, there is significant main effect of students' mental ability on achievement in Biology. Consequently, those with higher mental ability are expected to perform better than those with lower mental ability. This is confirmed in the post-hoc analysis.

Table 5:

Parameter Estimates of Achievement BY MENTAL Ability

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval		Partial Eta Squared
					Lower Bound	Upper Bound	
Intercept	50.442	3.024	16.679	.000	44.497	56.388	.413
Pre Achievement	-.125	.153	-.813	.417	-.426	.177	.002
Low	-5.884	2.434	-2.417	.016*	-10.670	-1.098	.015
Medium	-.727	2.715	-.268	.789	-6.065	4.611	.000
High	0[a]	.	.	.	.	.	.

a. This parameter is set to zero because it is redundant (Control). Dependent Variable: Post Achievement.

* Main effect is significant at 0.05

The results revealed that students with low mental ability have significant negative effect on achievement in Biology concepts at $t = -2.417$ ($p < 0.05$). Therefore, students with high mental ability significantly have higher achievement in Biology compared with low mental ability students while there is no significant difference in achievement between students with high and medium mental ability. Further, a unit increase in low and medium mental ability will decrease students' achievement by -5.884and -0.727respectively. The results are further supported using pairwise comparison of main effects.

Table 6

Post-Hoc Tests: Pairwise Comparisons of Means for Achievement

Dependent Variable: Post Achievement

(I) Mental Ability	(J) Mental Ability	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Low	Medium	-5.157*	1.857	.017	-9.621	-.693
	High	-5.884*	2.434	.048	-11.736	-.031
Medium	Low	5.157*	1.857	.017	.693	9.621
	High	-.727	2.715	1.000	-7.254	5.801
High	Low	5.884*	2.434	.048	.031	11.736
	Medium	.727	2.715	1.000	-5.801	7.254

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

The pairwise comparison results indicated that students' with high mental ability are more likely to have better achievement (performance), since there is significance mean difference in achievement compared to students' with

low mental ability at -5.884 ($p<0.05$) while the mean difference in achievement between medium and high mental ability students is not significant at -0.727.

Discussion

The study revealed that there was significant effect of treatment on students' achievement in Biology. Enhanced inquiry group had the higher mean difference out of the two treatment groups for the achievement gain by treatment. Enhanced inquiry group likewise had the highest mean. This finding shows the efficacy of enhanced inquiry. Enhanced inquiry involves the use of personal science journals where students can write out their ideas and teachers can easily discover the ideas that have been misconceived. This is to aid students learning and ultimately enhance their achievement. Students exposed to 5Es outperformed their counterparts taught using the lecture method. This could be because of the stages involved in 5Es. Pair wise comparisons of mean for achievement also indicated that students taught using enhanced inquiry and 5Es model had higher mean scores than those exposed to lecture method. This finding agrees with the studies of Annan et al (2019), Athuman (2017), Sharbu (2017), Ibrahim et al (2018), Opara (2011) and Blight (2010). They all studied and assessed the inquiry teaching method on academic achievement of students in Biology and found that there was a significant difference between the achievements of students taught with inquiry method and lecture method in favour of inquiry method. Also, the study by Ali (2014) who studied the effect of inquiry-based method on students' academic achievement in science found that students instructed through inquiry-based method achieved higher score than the ones instructed through traditional method. In addition, the study agrees with that of Adejo (2015) who also found that students taught with inquiry method performed significantly higher in chemistry than those taught with traditional method. These findings point out the efficacy/effectiveness of the inquiry method in students' achievement and explain that enhanced inquiry can even cause increased / greater students' achievement. This shows that combination of 5es strategy and inquiry is more effective in enhancing students' achievement in Biology than using only inquiry or 5es strategy.

Furthermore, effect of gender on students' achievement is not significant as shown in the result of the test of hypotheses. The result of this study is in line with the study of Ibrahim et al (2016) who found no significant differences in the performance of male and female students in Biology, Chemistry and Physics. Udeani (2012) found out that girls with higher self-efficacy performed as well as boys. The finding of this study is at variance with the work of Kashu (2014) who found that males performed better than females in a period of 5 years in Biology, Chemistry and Mathematics. However, this disagrees with the study of Filgona et al (2017), they discovered that female students performed better than their male counterparts.

Okoye (2016) in her study "influence of gender and cognitive styles on students' achievement in Biology" found that gender and cognitive styles have no significant influence on achievement scores of students in Biology. Her work is in consonance with this study in that no significant influence of gender on achievement in Biology is discovered. However, the study by Dofine et al (2018) disagrees with this in that they found that male students performed better than their female counterparts.

Aniodoh et al (2013) agrees with Filgon et al (2017), they found that female students performed better than their male counterparts when taught chemistry using inquiry role instructional model.

However, Ajayi et al (2017) found no significance difference in the mean achievement scores between male and female students taught stochiometry. Their work agrees with this study in that no significant difference was found between male and female students' achievement score.

In the work of Amedu (2015), the effect of gender on the achievement of students in biology using the jigsaw method, it was found that male students performed better than their female counterpart. This report is not in consonance with the findings of the present study but is in consonance with the study of Nnenna (2018) who found that male students achieved higher than their female counterparts in biology achievement test.

Inspite of the above, the work of Oludipe (2012) is in line with this study in that he found that there was no significant difference in the achievement of male and female students who are taught basic science. This shows that male and female students have equal chance of performing well as gender should not be a barrier to achievement. In addition, mental ability had a significant main effect on students' achievement in biology with high mental ability students having the most significant main effect on the achievement in Biology. This agrees with the work of Adeyemi and Awolere (2016) who found that there was a significant main effect of mental ability on students' academic achievement in Biology with high mental ability students having the highest adjusted mean score. Also, the study of Nnoron (2013) is in consonance with this present study in that she found that student with high reasoning skills

performed better in biology. In addition, Ezeugu et al (2016) found that there was a significant difference in the achievement mean scores of students with different cognitive abilities in favour of those with high cognitive ability.

Furthermore, Ishaku (2015) found in his study that high ability students outperformed their medium and low ability students respectively. This is also in consonance with the study by Pooja (2012) who discovered that students with higher mental ability tend to achieve highly in academics. Paulo et al (2017) also found that reasoning ability predict students' academic achievement in physics – chemistry. Likewise, Isabel et al (2018) found that cognitive reflection visual and verbal reasoning are intimately related and predict academic achievement. It can therefore be deduced that high mental ability students have higher chance of achieving better than medium and low mental ability students. Enhanced inquiry, inquiry and 5es instructional strategies utilized in this study have been found to improve students' achievement in Biology in that they performed better than their counterparts that were taught using conventional strategy commonly used in public schools. However, enhanced inquiry had the most significant effect on students' achievement. Enhanced inquiry, and 5es instructional strategies utilized in this study have been found to improve students' achievement in Biology in that they performed better than their counterparts that were taught using conventional strategy commonly used in public schools. However, enhanced inquiry had the most significant effect on students' achievement.

Conclusion

Enhanced inquiry and 5E model instructional strategies utilized in this study have been found to improve students' achievement in Biology in that they performed better than their counterparts that were taught using lecture method commonly used in public schools. However, enhanced inquiry had the most significant effect on students' achievement. In addition, gender did not affect students' achievement while mental ability had a significant effect on students' achievement because high mental ability students performed better than their counterparts of medium and low mental abilities**.**

Recommendations

The following recommendations are presented because of the findings of this study:

- Biology teachers should adopt enhanced inquiry to enhance students' achievement in Biology.
- Gender did not affect the achievement of student. It therefore implies that there should be no preferential treatment of either female or male students.
- Teacher educators should be professionally trained on the use of enhanced inquiry so that teachers- in training in turn become aware of the strategy before graduation from school.
- The teachers should make sure that group discussion session essential values are upheld for example not ignoring others' ideas.

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