Anatolian Journal of Education
e-ISSN: 2547-9652

October 2022 ● Vol.7, No.2
www.e-aje.net
pp. 19-30

Effectiveness of Guided Inquiry and Open Inquiry Instructionals Strategies in Improving Biology Students' Achievement

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In recent years, students' performance in Biology in the Senior Secondary Certificates Examination (SSCE) has not been encouraging. Studies have attributed fluctuating achievement of students in Biology to ineffective use of instructional strategies. If sustainable solution is not proffered to the issue of poor performance in Biology, it could hinder the fulfilment of educational goals for science, especially in the health sector. This study advocated the use of teaching strategies that will promote and encourage teachers to adopt learning strategies that will demand students to think critically and contribute effectively in class and the society at large. Therefore, this study was carried out to determined the effectiveness of guided and open inquiry instructional strategies on academic performance of secondary school students in Biology in Osun State. The non-equivalent pretest posttest quasi-experimental research design was used for the study. The population comprised all senior secondary school Biology students in Osun state. The sample consisted of Senior Secondary One (SS1) Biology students in their intact classes selected using multistage sampling procedure. Biology Achievement Test (BAT) was used to gather data for the study. Data collected were analysed using analysis of Covariance. From the study, the results showed that there was a significant difference between the experimental groups taught Biology using guided inquiry and open inquiry strategies, and the control group taught Biology using conventional method. Open inquiry strategy improve students' performance better than the other groups. Also, guided inquiry stimulate students' performance than conventional method. The study concluded that Open inquiry is a better teaching strategy; as it was more effective in improving the academic performance of students in Biology in the study area.

Keywords: science education, biology, science process skills, student's achievement, instruction

INTRODUCTION

There has been various discussions regarding the teaching and learning of Science overtime. This is because there has been increased emphasis on the development of individuals through innovation and development of creative ideas which is entrenched in the national policy of education (FRN, 2004). It was stated in the National Policy of Education that the first cardinal aim for effective scientific

Citation: Owolade, A. O., Salami, M. O., Kareem, A. O., & Oladipupo, P. O. (2022). Effectiveness of guided inquiry and open inquiry instructional strategies in improving biology students' achievement. *Anatolian Journal of Education*, *7*(2), 19-30. https://doi.org/10.29333/aje.2022.723a

teaching is to bring about development of scientific inquiry, and abilities in students towards creativity (FRN, 2013). Scientific teaching and learning is expected to promote the gaining of knowledge, skills and attitude which will culminate in societal development. The societal development is more paramount in recent times because the characteristic of the 21st century society is the advancement in science and technology. This advancement is supposed to bring about overall change in the perspective of individuals living in the 21st century society. For Nigeria to achieve this fast development in the 21st century, there is a need for qualitative science education in educational institutions especially in senior secondary schools.

Studies have attributed fluctuating learning outcomes in Science subjects like Biology to ineffective use of instructional strategies. Learning is a combination that is composed of human elements, materials, facilities, equipment, and procedures that affect each other in achieving the objectives of learning (Puspitarini & Hanif, 2019). Thus, the human elements in learning include students, teachers, education personnel, and so forth. These studies advocated the use of teaching strategies that will promote and encourage teachers to adopt learning strategies that will demand students to think critically and contribute effectively in class and the society at large (Kareem 2019, Omorogbe & Ewansiha, 2013). Ali, Toriman and Gasim (2014) explained how the academic performance of students in Biology has been on a decline in recent times. It was stated that in recent years, students' performance in Biology in the Senior Secondary Certificates Examination (SSCE) has not been encouraging. These has been attributed to various problems like unavailability of textbooks, laboratory apparatus and learning resources as well as teachers not using appropriate teaching methods (Ali et. al., 2014; Dinah, 2013). It has been observed also that Biology achievement in the past years in terms of success rate has been below 50% which is not that encouraging.

Arokoyu and Chimuanye (2017) buttressed the fact that the performance of students in Biology up until 2017 has been below 50%. It was also posited that the method of teaching was a significant factor affecting the academic performance of students in Nigeria. According to them, teachers as well as teaching methods have an important influence on students' performance. The method adopted is a means by which the translation of policy into action and principles is enacted based on practice and principles during interaction with the students. The method employed by the teachers in an attempt to impact knowledge on the students will determine what knowledge students will acquire after the lesson. The poor performance of students in science in external examination has also been attributed to poor teaching strategies. (WAEC Chief Examiner's Report, 2016). Different strategies have been introduced but these strategies could not improve the achievements of students in Biology (Nkechinyere & Arokoyu, 2018). It is then important that new and innovative strategies are used by teachers for effective teaching and learning. Thus, guided inquiry has been one of the specified strategies for the 21st century.

In Nigeria, external examination bodies like WAEC, GCE and NECO respectively conduct the Senior School Certificate Examination to determine the level of students 'academic performance at the last stage in secondary schools. The score obtained in the examination by candidates are graded such that scores from 100 to 60 are represented by A1-B3, 59 to 50 fall under C4-C6, ordinary Pass between 40 and 49 are D7-D8 and failure grade F9. Adeyemi (2011) recorded that between 2005 and 2010, majority of the sampled students who sat for West African School Certificate Examination in Biology obtained grades within the range of D7 –F9. This result shows that there was a record of poor achievement in Biology, since Nigerian tertiary institutions demanded for at least C6 to further their studies. In the words of Isiugo-Abanihe, Ifeoma and Tandi in Aniaku, (2012), this poor student achievement in Biology can be traced to the use of poor teaching methods such as Conventional lecture or expository method in the teaching and learning of Biology. However, Etuk, Maria, and Asukwo (2013) posited that the solid rock of education system lies on knowledgeable, competent, well-trained and devoted teachers. It was also stated that students' level of participation in the

instructional process is critical. Meanwhile, the students' perception gives way to operational challenges. It was opined that the way the students perceived knowledge and their achievement assists the teacher to change teaching strategies which will improve students' learning outcomes (Malik, Salman, Ameen, & Abdullahi, 2020). Shaibu, (2017) believes that the effective uses of inquiry and demonstration teaching methods should produce students with higher performance. Apart from teaching methods, socio-economic background, personality of the students, interest of the student and mastery of subject matter, emotional state of mind and teachers experience greatly influence academic performance. Considering the senior secondary school biology results in Anambra state between 2008 and 2016, it can be concluded that the result is relatively low.

The level of students' achievement was measured by the number of Students that scored credit and above. A report from WAEC officer out of 1,100,589 candidates that enrolled for Biology examination in 2008, only 423,403 (38.47%) passes with credit and a little above. Also, in 2009 (35.74%), 2010 (49.23%), 2011 (33.37%), 2012 (33.94%), 2013 (23.26%), 2014 (25.62%), 2015 (34.10%) and 2016 (36.02%) obtained credit pass and above in Biology. Again, 31.70%, 32.18%, 22.96%, 32.47%, 38.41%, 47.70%,47.63%, 34.80% and 31.89% recorded failure in 2008, 2009, 2010, 2011,2012,2013,2014,2015 and 2016 respectively (WAEC, 2008-2016). It was also recorded between 2004 and 2012 that students had poor academic achievement in NECO/SSCE Biology results. 57.56% of the candidates that sat for the examination in 2004 had credit and above (NECO, 2004-2012)

The ability of teachers to help students develop relevant, difficult questions that will take them through their inquiry process and inspire student-generated investigation, and learning is critical to open inquiry. As a result, in open inquiry, students' input in crafting an effective inquiry question is regarded vital. This inquiry requires the least amount of teacher intervention and it is student centered. Students here work in groups and are involved in the planning of all the phases in investigation (Shuaibu, 2017).

Many studies have been carried out on the effect of inquiry on learning outcomes of students but the different approaches to inquiry has not really been a subject of investigation. As effective as the inquiry methods have been as found in literature, not much has been done on comparing the different inquiry approaches to see which is more effective especially in improving learning outcomes. Guided inquiry has especially been an open play ground for researchers but little information is found on Open Inquiry. It is then important to assess the effectiveness of guided and open inquiry in improving the achievement of students. Hence, this study

Statement of the problem

Students' performance in Biology in the Senior Secondary Certificates Examination (SSCE) has not been encouraging in recent times. Studies have attributed the inconsistent achievement of students in Biology to ineffective use of instructional strategies. If this fluctuating performance in Biology continues, it could negatively impact the fulfilment of educational goals for science, especially in the health sector. This study advocated the use of teaching strategies that will promote and encourage teachers to adopt learning strategies that will demand students to think critically and contribute effectively in class and the society at large. On this premise was the study determined the effectiveness of guided and open inquiry instructional strategies, with a view to improving academic performance of secondary school students in Biology in Osun State, hence the study.

Objective of the Study

The specific objective of the study was to determine the effectiveness of guided and open inquiry instructional strategies in improving academic performance of secondary school students in Biology in Osun State.

Research Hypothesis

Based on the objective of this study, a research hypothesis was raised:

H_o There is no significant difference in the effectiveness of guided inquiry (GI) and open inquiry (OI) instructional strategies in improving academic performance of secondary school students in Biology in Osun State.

H_1 There is significant difference in the effectiveness of guided inquiry (GI) and open inquiry (OI) instructional strategies in improving academic performance of secondary school students in Biology in Osun State

Literature review

Academic performance is defined as the sum of a person's achievements following exposure to a learning program (Kareem, 2019). Campbell in Aniaku (2012), referred to academic achievement as the result of any teaching and learning process that is the level at educational goals of any institution is achieved. Similarly Adeyemi as cited by Aniaku (2012) described academic achievement as individuals' grades generated from examinations or continuous assessments can be used to determine intellectual skills. Grades generated from examinations or continuous assessments can be used to determine intellectual skills.

Academic performance, according to Ibrahim (2015), is defined as behaviours that ensure that goals are continuously met in an effective and efficient manner. Academic performance, according to the author, is the efficacy and improvement of pupils in achieving certain goals. According to Ibrahim (2015), the influence of teaching methods and effectiveness on students' learning outcomes, as evaluated by students' academic achievement, is a strong predictor of students' academic performance.

Franklin, (2015) said that Inquiry helps the students develop autonomous and in depth thinking skills, curiosity and good attitude toward learning. Warner and Myers (2014) asserted that in making use of the inquiry process of learning and to increase the knowledge abilities of the learners, the teacher has a role to play. The responsibility of the teacher while using the inquiry-based lessons are to start the inquiry process, promote student relationship in small groups and encourage them to participate in class discussions, stepping up to address misconceptions and to develop students' understanding of topic, shaping attitudes and utilizing student experiences to create new content knowledge.

Open inquiry depends on the teachers ability in raising appropriate and challenging questions that will guide the students and arouse their interest in learning during the learning process. This process of students' participation in raising appropriate inquiry question is important while the teachers guide the students in decision making and carrying out the decision at every stage of the inquiry. Open inquiry also depends on the students' cognitive ability. The knowledge of the students' cognitive ability will help teachers maximize and help them appropriately. Teachers in this type of Inquiry don't fully participate because it is student-centered learning. Students work and plan all phases of their investigations in groups. Cheval and Hart (2005) agreed that this form of inquiry is easiest in teaching science in schools. In summary, students generates their own questions, formulate investigative methods, carry out the inquiry and present the result at the end of the process.

Irinoye, Bamidele, Adetunji and Awodele, (2015) stressed the importance of guided inquiry by explaining how it aids students' academic performance in science. Guided enquiry helps students to discover different abilities on their own and helps to promote understanding and individual learning. Uzezi and Zainab (2017) also believed that guided inquiry encourages students to engage in scientific researches and also pick up a career that would involve hands on activities. It is important to teach science using guided discovery method as it promotes and encourages investigation as rightly stated by Adetunji (2007) that investigation is an important component in teaching so that students can learn to discover themselves. It is assumed that guided inquiry strategy will assist learners to form their own concepts and consequently enhance performance, skills and self-efficacy in Biology. One of the most notable features of the guided inquiry is that "the teacher provides only the materials and problem to investigate but they are still regarded as important since they provide inquiry questions while students

devise their own procedure to solve the problem" (Colburn, 2000). Well-structured questions led to Goals for the inquiry, as well as how to prepare students to be fully engaged in the process (Martin-Hauser 2002). Student-led guided inquiry is facilitated by the teacher. According to Saduwa (2017), who conducted a review of related literature on the usage of guided-inquiry method of instruction, guided-inquiry style of instruction resulted in superior performance in Integrated Science than conventional mode of instruction. Ugwuadu (2010) both found that directed inquiry increases students' performance. According to Fatokun and Yalams (2017), the strategy improves students' attention, confidence, innovativeness, and problem-solving abilities, and hence their performance in both theory and practice.

METHOD

The study adopted non-equivalent pre-test, post-test quasi-experimental design. Three groups were created for the study. The First group (Experimental Group I) represents Guided Inquiry, the second group (Experimental Group II) represents Open Inquiry strategy while third group which served as the control group was the conventional method (i.e. Teacher expository teaching strategy). The pre-tests for performance were administered before treatment. Also, the post-tests for performance were administered after the treatment. The design for the study is presented schematically below:

Experimental Group I	O_1 X_1 O_4
Experimental Group II.	O_2 X_2 O_5
Control Group	O_3 O_6

Where

O_1 O_2 O_3 == Pre-test for Exp. Group I, Exp. Group II & Control Group respectively
O_4 O_5 O_6 == Post-test for Exp. Group I, Exp. Group II & Control Group respectively
X_1 == Treatment using guided inquiry strategy
X_2 == Treatment using open inquiry strategy

Independent variables include treatments used for the study which are Guided and Open Inquiry strategies. The dependent variable was students' performance. The research design used validated the effectiveness of the variables and helped in the evaluation of Independent variables' effectiveness on academic performance in studying Biology.

Population, sample and sampling technique

Target study population comprised Senior Secondary School Biology students in Osun State. The sample for the study consisted of Senior Secondary School One (SSS I) Biology students in Ile-Ife. Multistage Sampling Procedure was used to select the sample for the study. From the three senatorial district of Osun state, one senatorial district was selected using simple random sampling technique. One-Local Government Areas (LGA) was then sampled from the selected senatorial district using simple random sampling technique. Furthermore, three schools were selected using simple random sampling technique from the selected Local Government Area. One intact SS1 science class which was the science arm of the class was purposively selected in each of the schools. The purpose was because only Science classes are compelled to take Biology in secondary schools in Nigeria. The three intact classes were assigned to three groups using simple random sampling technique. Students in experimental group A were-exposed to guided inquiry while those in experimental group B were-exposed to open inquiry instructional strategy and those in experimental group C were taught-using conventional method. The topic taught was basic ecological concepts. The sub topics under this topic include environment, biosphere, lithosphere, atmosphere, habitat, population, and components of an ecosystem. Three research assistants, who are Biology teacher were trained in each school on the purpose of the intervention. The treatment lasted for four weeks. The selected schools for the study were shown in table 1:

Table 1
Schools selected and assignment to-treatment

Group	Name-of school	Treatment type	No of students
A	Oduduwa College, Ile-Ife	Guided Inquiry	39
B	St. David Grammar School, Ile-Ife	Open Inquiry	44
C	Seventh Day Grammar School, Ile-Ife	Expository (Control group)	35
		Total	118

The secondary schools in Osun State have been assigned by the formal governor to operate as mega schools. Thus, some schools were packed together, which made a unified background achievable.

Research Instruments

Biology Achievement Test (BAT) was used to collect data for the study. Biology Achievement Test((BAT) which was used to determine the academic performance of Biology students and was developed by the researcher from the standardized test of West African Examination Council (WAEC 2000-2019).

Reliability of BAT

The test was administered to twenty respondents from the representative sample selected for the pilot study. Difficulty index (P) and discrimination index (D) was considered such that items whose difficulty index was $0.25 \leq P \leq 0.75$ and the discrimination index (D) was $0.4 \leq D \leq 0.6$ were retained (as soon in table 2). Attthe-end of the validation, twenty-eight items out of 53 met the difficulty and discrimination criteria, hence were retained. Kuder Richardson 20 was then used to determine the reliability. A reliability score of 0.72 was gotten and the remaining instruments were judged reliable.

Table 2
The instructional package consists of topics on guided inquiry and open inquiry instructional strategies

Item	Difficulty	Discrimination	Decision	Item	Difficulty	Discrimination	Decision
1	0.0	0.00	Reject	28	0.15	-0.10	Reject
2	0.8	0.40	Accept	29	0.75	0.60	Accept
3	0.35	0.40	Accept	30	0.50	0.40	Accept
4	0.90	-0.10	Reject	31	0.50	0.40	Accept
5	0.70	0.40	Accept	32	0.40	0.40	Accept
6	0.75	0.40	Accept	33	0.30	0.40	Accept
7	0.70	0.50	Accept	34	0.70	0.40	Accept
8	0.10	-0.10	Reject	35	0.55	0.50	Accept
9	0.25	0.30	Reject	36	0.15	0.30	Reject
10	0.25	0.30	Reject	37	0.30	0.40	Accept
11	0.70	0.60	Accept	38	0.55	0.40	Accept
12	0.25	0.20	Reject	39	0.45	0.50	Accept
13	0.80	0.50	Accept	40	0.90	0.10	Reject
14	0.35	0.40	Accept	41	0.25	0.30	Accept
15	0.85	0.70	Accept	42	0.45	0.40	Accept
16	0.35	0.40	Accept	43	0.25	0.50	Accept
17	0.35	0.30	Reject	44	0.35	0.30	Reject
18	0.35	0.30	Reject	45	0.45	0.50	Reject
19	0.35	0.30	Reject	46	0.15	0.10	Reject
20	0.15	0.15	Reject	47	0.40	0.40	Accept
21	0.3	0.20	Reject	48	0.25	0.10	Reject
22	0.50	0.40	Reject	49	0.50	0.60	Accept
23	0.3	0.20	Reject	50	0.80	0.70	Accept
24	0.35	0.30	Reject	51	0.50	0.60	Accept
25	0.15	0.10	Reject	52	1.00	0.00	Reject
26	0.45	0.50	Reject	53	0.75	0.70	Accept
27	0.50	0.40	Reject				

These treatment instructional packages included were;

(a) Guided Inquiry Strategy (GIS);
(b) Open Inquiry Strategy (OIS);

The topic taught was Basic Ecological Concepts using guided and open instructional strategy. However, with the use of guided inquiry, the students are allow to investigate questions and procedures that teachers present to them, but the students themselves, through collaborative work decides the processes to be followed to achieved the targeted solution. On the other hand, in open inquiry class, the teacher introduces the knowledge framework in which the inquiry will be conducted, but allows the students to select a wide variety of inquiry questions and approaches. Thus, students are engaged in continuous decision-making throughout each stage of the open inquiry process, starting from the stage of finding the interesting phenomenon to be inquired.

The research procedure consisted of three stages, the pre-treatment, treatment and posttest for achievements. The BAT was administered to the students in the three selected schools to ascertain their achievement in Biology, before the treatment was administered.

The post-treatment stage started two weeks after the treatment stage was over. The post-test (BAT) was administered to the three groups, the scripts were collected for marking and coding respectively, before analysis were then carried out on them. The post-test measured the achievement of the respondents in each school.

Data collected were analysed using descriptive statistics (mean and standard deviation) and inferential statistics (ANCOVA). The hypotheses were tested using Analysis of Covariance (ANCOVA). Post-Hoc analysis was also carried out where necessary. All hypotheses were tested at 0.05 level of significance

FINDINGS

Research Hypothesis: H_o There is no significant difference in the effectiveness of guided inquiry and open inquiry instructional strategies on academic performance of secondary school students in Biology in Osun state

H_1 There is significant difference in the effectiveness of guided inquiry and open inquiry instructional strategies on academic performance of secondary school students in Biology in Osun state

To test the null hypothesis, the scores of the respondents to the Biology Achievement Test (BAT) were collected from the pre-test and post-test and then were subjected to Analysis of Covariance (ANCOVA). The pre-test scores act as covariate to provide a background knowledge on the performance of the students before the treatment was administered. The posttest was then administered after the treatment has been administered to the students. The result of the analysis using the Statistical Package for Social Sciences (SPSS) is presented in Table 3.

Table 3
ANCOVA table of the post test score of the academic performance of students exposed to GI and OI in Osun state secondary schools

Tests of Between-Subjects Effects						
Dependent Variable: Post test						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	155.370[a]	3	51.790	4.096	0.008	0.089
Intercept	1047.624	1	1047.624	82.857	0.000	0.397
Pretest	6.555	1	6.555	0.518	0.473	0.004
Group	153.384	2	76.692	6.066	0.003	0.088
Error	1593.122	126	12.644			
Total	20806.000	130				
Corrected Total	1748.492	129				
a. R Squared = 0.089 (Adjusted R Squared =00.067)						

From Table 3, the post test result showed that F = 6.066, p < 0.05. This implies that a significant difference existed in the effectiveness of guided inquiry and open inquiry instructional strategies on academic performance of secondary school students in Biology in Osun state. Hence, the null hypothesis that states that there is no significant difference in the performance of students exposed to guided inquiry and open inquiry strategy was rejected. A Partial Eta Squared value of 0.088 showed that the strategies used accounted for 8.8% variation in the performance of the students exposed to the two strategies.

A pairwise comparison Post- Hoc analysis was then carried out on the two groups to determine the direction of difference in the performance of students in the two groups.

Table 4
Scheffe PostHoc comparison of the effectiveness of GI and OI strategies on academic performance

Multiple Comparisons						
Dependent Variable: Post test						
Scheffe						
		Mean			95% Confidence Interval	
(I) group	(J) group	Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
OI	GI	2.0323*	0.78069	0.037	0.0986	3.9660
	Conventional	2.2258*	0.73728	0.012	0.3996	4.0520
GI	OI	-2.0323*	0.78069	0.037	-3.9660	-0.0986
	Conventional	0.1935	0.86415	0.975	-1.9469	2.3340
Conventional	OI	-2.2258*	0.73728	0.012	-4.0520	-0.3996
	GI	-0.1935	0.86415	0.975	-2.3340	1.9469
Based on observed means.						
The error term is Mean Square (Error) = 12.596.						
*. The mean difference is significant at the 0.05 level.						

OI- Open Inquiry
GI- Guided Inquiry

The pairwise comparison in Table 4 showed that there is a significant difference in the performance of students exposed to guided inquiry and those exposed to open inquiry ($p<0.05$) with those exposed to the open inquiry strategy performing better than those exposed to guided enquiry with a mean score of 2.03. There was also a significant difference in the performance of those exposed to Open Inquiry and Conventional Strategies ($p<0.05$) as those exposed to Open Inquiry strategy also performed better with

a mean difference score of 2.22. No significant difference exist in effectiveness of guided inquiry and conventional strategies ($P<0.05$).

DISCUSSION

The study sought to examine the comparative effectiveness of open and guided inquiry strategies on the learning outcomes of Biology students in Osun State. In order to achieve this, three objectives were raised and tested.

Result from research hypothesis found that a significant difference exists in the academic performance of Biology students taught using Guided inquiry and those taught using Open inquiry, with those taught using Open inquiry strategy performing better than those taught using Guided inquiry. This result is consistent with that of Kang (2020) who in his study among secondary school science students in Finland found that open inquiry strategy had overruling effects on guided inquiry strategy especially in the aspect of science literacy and academic achievement of students. Plausible reason why open inquiry strategy performed better could be due to the fact that the strategy enhances science knowledge and also improve relationships between teachers and students (Kang, 2020), as well as enhances students' well-being and life satisfaction at school (OECD, 2017) and promote deeper understanding of complex scientific issues (Franklin, Xiang, Collett, Rhoads & Osborn, 2015). According to Reid and Yang (2002), students who participated in open enquiry instructional strategy demonstrated ownership and took responsibility for deciding the objective of the inquiry and proposed concerns to be investigated like a scientist would. The result is also in consonant with Zion and Slezak (2005), which says that Open inquiry fosters a learning atmosphere for teachers and students, which helps the inquiry process succeed. According to Njoku (2004), inquiry-based learning is largely a pedagogical strategy established during the discovery learning movement of the 1960s as a challenge to traditional forms of education, as described by Martins-Omole (2015). By integrating what they already know with what they have learnt, the students employ the inquisitive process to build expiations from their observations. They learn biology principles, abilities, and how to handle problems using a practical approach. Students must do more than merely report on a topic in inquiry-based learning. The result is also in line Naureen and Jeffery (2010), who discovered that the learning process is effective when the Students take initiative and practice what they have learnt.

From the result, it was discovered that students taught Biology using guided inquiry performed better that those taught using conventional method. Also, this result is in line with that of Adeuya (2020) conducted among secondary school students in Ekiti State. Adeuya (2020) discovered that students taught with guided inquiry performed better in Biology than those taught with conventional method. According to Saduwa (2017), who conducted a review of related literature on the usage of guided-inquiry method of instruction, guided-inquiry style of instruction resulted in superior performance in Integrated Science than conventional mode of instruction. Fatokun and Yalams (2013) and Ugwuadu (2010) both found that directed inquiry increases students' performance. According to Fatokun and Yalams (2017), the strategy improves students' attention, confidence, innovativeness, and problem-solving abilities, and hence their performance in both theory and practice. The result is also in agreement with Naureen and Jeffery (2010), who stated that, it is important for the teachers to make suitable changes and arrange the classroom well for effective use of hand on investigative activities, use of science journals and guide students to reflect and think on their learning process in order to facilitate inquiry-based learning.

CONCLUSION

Based on the findings of the result of the study, it was concluded that a significant difference existed in the effectiveness of guided inquiry and open inquiry strategy in improving academic performance of secondary school students in Biology in Osun state, as those exposed to open inquiry strategy

performed better than the other groups. Also, a significant different existed between guided inquiry and conventional method, as the students taught Biology using guided inquiry performed better that those in conventional group.

Moreover, the study concluded that Open inquiry is a better teaching strategy; as it was more effective in improving the academic performance of Biology students in the study area.

RECOMMENDATION

Based on the findings of the study, it is however recommended that, Teachers should be encouraged to use innovative teaching strategies such as open inquiry instructional strategy, since it is found useful in improving the academic performance of students. Also, further study should be carried out to determine the effect of open inquiry instructional strategy in teaching and learning of other topics in Biology, such as Genetics, seeds and fruits, Reproduction in flowering plants, and so on.

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