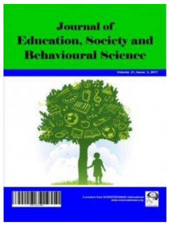

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Analogy and Guided Inquiry Instructional Strategies and Students' Achievement in Basic Science in Lagos Metropolis, Nigeria: Way Forward for Effective Science Teaching and Learning

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Authors' contributions

This work was carried out in collaboration between both authors. Author EUE designed and supervised the running of the project, and revised the manuscript for important intellectual content. Author AAS managed the literature searches and performed the statistical analysis. Both authors read and approved the final manuscript.

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ABSTRACT

Effective teaching of science brings about meaningful learning of science and unless concepts in science are learnt meaningfully, they cannot be applied to solve real- life-problems. In the quest to solve these real life-problems, scientific knowledge should be effectively utilized. This study, therefore, examined the main effects of analogy and guided inquiry instructional strategies on students' achievement in basic science. One hypothesis was generated and tested at 0.05 levels of significance. The study adopted a Pretest-Posttest Control Group Quasi-experimental research design. The experimental groups were exposed to analogy and guided inquiry instructional

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strategies and the control group was exposed to the modified conventional lecture method. The participants for the study were 202 (115 males and 87 females) junior secondary school (JSS II) or Basic 8 Basic Science Students selected from six secondary schools. The treatments were found to have significant effects on students' achievement in basic science. The result obtained showed that analogy instructional strategy contributed most to students' achievement in basic science. It was concluded that analogy instructional strategy improved students' achievement in basic science and is therefore recommended for use by basic science teachers in secondary schools.

Keywords: Analogy; guided inquiry; basic science and achievement.

1. INTRODUCTION

Basic science is offered at the basic education level in Nigeria. Federal Republic of Nigeria [1] refers to basic education as a 9-year duration comprising 6 years of primary education and 3 years of junior secondary education. Basic Science is taught in a holistic form so as to express the fundamental unity of scientific knowledge at this level. According to Adewumi [2], Basic Science is an approach to the teaching of science in which concepts and principles are presented, so as to express the fundamental unity of scientific concepts without any bias to the compartmentalized Science. It is a subject which embraces all science subjects, namely Biology, Chemistry, Physics, and Mathematics, therefore, is a subject that cuts across the school curriculum and needed in all branches of science, applied science, and social science.

Basic Science prepares students for senior secondary school science subjects and future career in science-related fields. Godpower and Sopuruchi [3] and Kabutu, Oloyede and Ogunsola-Bandele [4] submitted that basic science is a fundamental subject expected to provide the foundation of learning science at the senior secondary school level and subsequently for science-related courses at higher institutions. The objectives of basic science at the junior secondary school level includes the acquisition of skills which includes, observation, complete and accurate reporting, organization and generalization of information and prediction skills, [5]. Despite the importance placed on basic science in the development of scientific knowledge in the country, the performance of students in the subject is worrisome.

Poor performance in basic science at the junior secondary school level is a thing of worry because of the role it is supposed to play in the subsequent learning of science at a higher level [6]. Edokpayi and Suleiman [7] reported that the academic achievement of students in JSCE basic science among selected schools in Zaria metropolis, Kaduna state, Nigeria, was a poor predictor of their later achievement in Chemistry. Also, Adebayo [8] reported that the academic achievement of students in JSCE basic science was a poor predictor of their later achievement at SSCE. Several reasons had been given for students' poor performance in the subject to include lack of well-equipped laboratory, lack of qualified teachers, and methods of teaching adopted by the teacher.

In most of our schools, science is being taught using the conventional method. Agboghoroma [9] states that Basic Science as a school discipline in the Nigerian educational system relies solely on the use of lecture/expository methods of teaching instead of an activity-based method of teaching. The conventional method is teacher-centered and students are mostly passive learners. Traditionally the style of teaching in the past follows a pattern such that a teacher sees himself/herself as a sole authority, therefore teaching is seen as telling, and learning implies passive "listening" [10]. Some limitations which may prevail in traditional teaching method are: teaching in classroom using chalk and talk is "one way flow" of information, teachers often continuously talk for an hour without knowing students response and feedback, the material presented is only based on lecturer notes and textbooks, teaching and learning are concentrated on "plug and play" method rather than practical aspects, there is insufficient interaction with students in classroom.

Scrivener [11] imagined conventional teaching as 'jug and mug' – the knowledge being poured from one receptacle into an empty one. He stated further that this attitude is based on the notion that "being in a class in the presence of a teacher and 'listening attentively' is enough to ensure that learning will take place". Thus, this had created the teacher-centered teaching methods with the teacher dominating at the expense of students not being encouraged to construct their own knowledge or take an active part in their learning. It must be noted that students' achievement and productivity in any course is a function of instruction. Approaches to instruction therefore are considered a serious issue in Basic science, especially with the current emphasis on competency and sustainable Science education.

There is a paradigm shift from teacher centre methods of teaching where the lessons in science should be student-centred, activity-oriented and focused on understanding which will eventually lead to subject mastery rather than rote-learning and simple recall of knowledge. As such, the role of the teacher has gradually changed from a traditional disseminator of information to that of a mentor, tutor or a guide. In this role, the teacher assists students with sources of information and provides them with guidance on analysis, interpretations, and report of findings. The teacher becomes, rather a facilitator of learning than a sage-on-the-stage [possessor and communicator of ultimate scientific wisdom, Ukoh [12], but a guide on the side. In this role, the students will become productive and able to apply their classroom knowledge to the real-life situation.

Globally, the list of methods of teaching Basic science is inexhaustible due to the fact that knowledge is dynamic, some teaching strategies are general to all subjects and some are specific to some disciplines. Duyilemi [13] advised that students should be given the opportunity to be actively involved in the learning process. This has, therefore, created room for a further search for other instructional strategies that could possess enough appeal to the learners and that would help to achieve the objectives of basic science education. All these calls for constructivist-based teaching strategy in science, Ukoh [12]. In an attempt to ensure result-oriented delivery in schools, Akubuilo [14] suggested the use of activity-oriented strategies such as cooperative learning, demonstration, thinks and do and many others. Though these strategies have helped in increasing students' knowledge in basic science, more still need to be done. The challenge for the teachers and educators is to adopt participatory, value-oriented and innovative strategies for teaching basic science in an efficient way. This need has necessitated new research into strategies that would focus on all the three domains of education; cognitive (students' knowledge), affective (attitude) and psychomotor (practices). Such strategies should enhance positive interactions and friendship among students. Teachers and students need to work together so that basic science concepts could be better understood. Therefore, in this study, the researchers use analogy and guided inquiry in the teaching and learning of Basic Science to determine its effectiveness on the achievement of students in Basic Science.

The concept of analogy goes back to the ancient Greeks. According to Esper [15], the word analogy derives from the Greek word 'analogia'; 'ana' means a collection of words or items and 'logos' means reason. One of the earliest recorded instanced of analogy being used to solve a scientific problem was that of Archimedes. He was given the task of determining whether the king's intricately designed crown was a pure gold or mixed with a base metal. The ultimate solution of melting the crown seemed unacceptable. Ever thoughtful, when Archimedes stepped into the bath and the tub overflow, he had an analogical insight. Seeing that his bodyweight displaced a specific amount of water, Archimedes realized that a gold bar will do the same. After receiving this analogical insight, Archimedes is said to have run through the street shouting 'Eureka, eureka'. All that was needed was a gold bar of the exact designated weight of the crown. If he put them in identical containers of equal amounts of water, and the crown and a gold bar displaced identical amounts of water, the crown was of pure gold. Legend has that it was Goswani [16].

Throughout history, analogies have played an important role in scientific discoveries, not as proof, but as inspiration. Analogies have also played an important role in explaining those discoveries Kaiser [17]. For example, Johannes Kepler, the famous seventeenth century astronomer, wrote: "I especially love analogies, my most faithful masters, acquainted with all the secrets of nature" Vickers [18]. Kepler, who discovered laws of planetary motion, used analogies to help explain his discoveries: "I am much occupied with the investigation of the physical causes. My aim in this is to show that the celestial machine is to be likened not to a divine organism but rather to how a clockwork" Holton [19].

Analogical comparison operates through aligning and mapping two examples problem representations to one another and then extracting their commonalities. Analogy juxtaposes two knowledge domains that bear little or no surface similarity but share a common relational structure. An analogy can function as a double-edged sword instructional strategy; it can at once facilitate meaningful learning and promote confusion and misunderstanding if not properly handled. Analogy improves students understanding of scientific concepts which invariably will lead to improving achievement. In a review of related literature in the use of analogy mode of instruction, Ugur, Dilber, Senpolat and Duzgun [20] and Okoronka and Wada [21] in their different studies concluded that analogy leads to a better conceptual understanding of electric concepts which in turn leads to improve the performance of students. Dincer [22] concluded that analogies had a positive impact on students' academic success, and it raises the level of information retention.

Inquiry learning is compatible with the constructivist approach, which emphasizes the idea that knowledge is not transmitted directly from the teacher to the student, but is actively developed by the student. Inquiry-based teaching/learning varies in the amount of autonomy given to students and encompasses a broad spectrum of approaches, ranging from teacher-directed structured and guided inquiry to student-directed open inquiry National Research Council [23].

Guided inquiry enables students to investigate questions and procedures that teachers present to them, but the students themselves, working collaboratively, decide the processes to be followed and the solutions to be targeted. The results are not foreknown to the teachers and students. In the guided inquiry, the teacher provides the student with inquiry questions and procedures, and therefore this decreases the level of uncertainty during the inquiry process. The students ultimately lead the inquiry process, are involved in decision making from the data collection stage and may come up with unforeseen yet well-conceived conclusions Zion and Mendelovici [24]. In this strategy, students receive some assistance and guidance from the teacher to enable investigation into a problem and construction of knowledge.

The guided inquiry has a prominent feature, which is that "the teacher provides only the materials and problem to investigate, while students devise their own procedure to solve the problem" Colburn [25]. Students at this level should be skillful enough to be able to design their own investigations. However, the teacher is still considered the cornerstone, since he provides the inquiry-driven questions. Very well-articulated questions that pave the way to the inquiry objectives and prepare students to be entirely involved are the essence of the guided-inquiry Martin-Hauser [26]. Guided inquiry is student-led, it is teacher facilitated.

In a review of related literature in the use of guide-inquiry mode of instruction, Saduwa [27] posited that guided-inquiry mode of instruction yielded better performance in Integrated Science than conventional mode of instruction. The study by Fatokun and Yalams [28] and Ugwuadu [29] both affirmed that guided inquiry improves students' achievement. Fatokun and Yalams [28] pointed out that the method helps to increase the degree of students' interest, confidence, innovativeness, problem– solving ability and consequently improve their performance in both theory and practice.

Though Areola [30] and Novak [31] submitted that no single method is best for teaching Basic Science, they unanimously agreed that method that would involve active students' participation such as analogy and guided inquiry would ensure higher performance. Therefore, the desire to improve Basic Science achievement through more effective instructional strategy and the increasing awareness, in recent years of learner-centredness has focused attention to understanding how learners learn and how to help them learn Jegede, Alayemola, and Okebukola [32].

This paper, therefore, seeks the effect, analogy and guided inquiry strategies have on students' achievement in Basic Science.

These strategies (analogy and guided inquiry) are grounded on the social constructivism theory of Jerome Bruner. According to Bruner [33], the purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem-solving skills which can then be transferred to a range of situations. Bruner [33] proposes that learners' construct their own knowledge and do this by organizing and categorizing information using a coding system. Bruner believes that the most efficient way to develop a coding system is to discover it rather than being told it by the teacher. The concept of discovery learning implies that students construct their own knowledge for themselves (also known as a constructivist approach).

Bruner believes that the ability to compare new stimuli with existing structures is critical to learning and development. In fact, the inability to interpret information based on existing mental structures would lead to a failure to adapt higher, more sophisticated mental structures and, hence, to fail to develop cognitively. In regard to this comparison, Bruner's theory suggests that children must develop ways to represent recurrent regularities in their environment. This representation system is developed through the building and establishment of progressively more sophisticated and specific mental schemes or structures [34].

To this end, Bruner [35] recognized three modes of representation that must be present at all stages of development. These three modes of representation (enactive, iconic, and symbolic) are not necessarily hierarchical, but some learning can only be achieved by passing through each type in a specific developmental order. Enactive representation can only demonstrate the past through appropriate motor experiences. If the enactive mode is the only one being employed, the learner could only demonstrate knowledge by using motor activity to demonstrate thinking. He or she could demonstrate how to do a particular task but could not explain or use any symbolic medium to express knowledge.

Iconic representation employs the use of organizational structures, spatial signifiers, or images to represent past experiences. Someone using this type of representation could relate an experience to images or concrete symbols like maps or diagrams. The third mode of representation is symbolic. In this mode, design features that can include remoteness or arbitrariness represent the past. Language is the most common tool used for this type of representation, but the characterizing feature of this type of representation is that the symbols being used do not have to have a concrete correlation to what is being described (Lutz and Huitt, [36].

As a constructivist, Jerome Bruner believed that children construct knowledge internally by engaging in discovery learning, selecting and transforming information, constructing hypotheses and making decisions. Bruner also believed that learners rely on an internal cognitive structure to bring meaning and organization to learning experiences. He also saw a direct role for interaction between a learning child and others in the learning environment and saw the role of the teacher as that of translating information into a format appropriate to each child's current state of understanding (Clark [37]. Bruner ideas are used in analogy and guided inquiry strategies as these two strategies as according to Audet and Jordan [38] says, the process, "the attempt to draw meaning from experience," is the important step for learning. This applies whether working with hands-on, experimental science or trying to learn from the lessons of history.

1.1 Statement of the Problem

The persistent low achievements of students in Basic Science both at internal and external examinations has been a source of concern to Science educators and researchers. Several factors have been adduced to be responsible for this trend; these include instructional strategies adopted in teaching such as lecture method, inadequate science process skills and lack of confidence in tackling Basic Science problems.

Efforts had been made in the past by Science educators and researchers to influence positively students' academic performance and mastery in the subject. Some of these efforts include encouraging teachers to imbibe positive attitude towards the subject which in turns influence students' achievement mastery in the subject. Also, teachers are being encouraged to adopt the modern teaching strategies that are activity oriented and students centred. These will engender in the students a sense of responsibility. One effective way to deal with this problem is for the teacher to provide a bridge between the unfamiliar concepts and the knowledge which the student possesses. This study, therefore, will determine the effect of analogy and guided inquiry instructional strategies on secondary school students' achievement in Basic Science.

1.2 The Significance of the Study

This study is considered significant because the findings would provide relevant information on the joint and independent effect of these two instructional strategies used. It would hopefully encourage active participation of the learners, thus leading to meaningful learning as learners participate in the activities during the teaching/learning process and in turn improve their achievement in basic science.

1.3 Scope

Six co-educational Junior Secondary Schools were purposively selected from Mushin and Surulere Local Government areas of Lagos State Nigeria. Intact class of one arm each was used in all selected schools. The study focused on the effects of analogy and guided inquiry instructional strategies on students' achievement in some concepts in Basic Science. The topics that were treated during the course of the study are transport system, respiratory system, and excretory system.

1.4 Hypothesis

One hypothesis was tested

H01: There is no significant main effect of treatment on students' achievement in basic science.

2. METHODOLOGY

2.1 Research Design

The pretest-posttest control group quasi-experimental research design was adopted for this study. The experimental groups were exposed to analogy instructional strategy (AIS) and guided inquiry instructional strategy (GIIS) while the Control Group was exposed to Modified Conventional instructional strategy (MCIS).

2.2 Selection of Participants

The target population comprised of all Junior Secondary School (JSS II) or Basic 8 students from six junior secondary schools from two Local Government Areas of Lagos State, Nigeria, which were randomly selected. The six junior secondary schools were purposively selected based on the presence of qualified Basic Science teacher, the readiness of the Basic Science teacher and students to participate in the study and co-educational nature of the school. Six intact classes were used and the total number of participants used for the study was 202 Junior Secondary School (JSS II) or Basic 8 Basic Science students (115 males and 87 females). The selected schools were then randomly assigned to treatment and control group respectively.

2.3 Research Instrument and Teaching Materials

The following instrument and materials were used in the course of the study:

1. Basic Science Achievement Test (BSAT)
2. Teachers Instructional Guide on Analogy Instructional Strategy (TIGAIS)
3. Teachers Instructional Guide on Guided Inquiry Instructional Strategy (TIGGIIS)
4. Teachers Instructional Guide on Modified Conventional Strategy (TIGMCS)

2.4 Basic Science Achievement Test (BSAT) and its Validity

BSAT was designed to measure students' performance (cognitive level) in specific academics areas (transport system, respiratory system, and excretory system). The test consisted of twenty (20) multiple choice items that covered the selected topics in the secondary schools' syllabus. Each correct answer in BSAT was rewarded one mark; to make a total of 20 marks. The options range from A to D. The multiple choice type of question was adopted for the study because it allows for objectivity in scoring and easy comparing of students achievement scores. The average difficulty and discriminating indices were determined after the instrument had been trial-tested on students in a separate school. The difficulty index was 0.40 and the reliability coefficient of 0.79 was obtained using Kuder Richardson (KR20), to establish the internal consistency of the items.

2.5 Teachers Instructional Guide on the Use of Analogy Instructional Strategy (TIGAIS)

This outlines the steps involved in presenting the AIS package to the students in analogy instructional strategy group (Experimental group I); it has the following steps:

1. Introduce the target concept to be learned
2. Cue the students' memory to the analogous situation
3. Identify the features of the analog that are relevant
4. Map the similarities between the analog and the target
5. Identify the analog-target links where the analogy breaks down

6. Summarize, drawing a conclusion about the target concept

2.6 Teacher Instructional Guide on the Use of Guided Inquiry Instructional Strategy (TIGGIIS)

This outlines the steps involved in presenting the course content to the students in interactive invention strategy group (Experimental II) it has the following steps:

1. Grouping of learners
2. Asking questions
3. Students think and interact with the instructional materials to discover and formulate a response to the questions
4. Student share their ideas with their group members
5. Student discuss their ideas with the whole class
6. Conclusion
7. Evaluation

2.7 Teachers Instructional Guide on Modified Conventional Strategy (TIGMCS)

This is an instructional guide for teachers that participated in the classroom using the traditional method/lecture method of teaching. The steps include:

1. The teacher introduces the lesson by asking questions based on the students' previous knowledge.
2. Teacher presents instructional aid and discusses the contents of the lesson with the students.
3. Teacher directs students to write the chalkboard summary in their notebooks.
4. Teacher evaluates the lesson by asking students some questions in class, later on homework/assignment.

The study lasted six (6) weeks. One week was used for training of teachers on the use of the three instructional guides. Basic Science Achievement Test (BSAT) was administered to the participants as a pretest for one week. Three weeks was used for treatment (two experimental groups were exposed to AIS, GIIS and the control group was exposed to MCS). Basic Science Achievement Test (BSAT) was administered to the participants as posttest for one week.

The analysis of the data obtained was done using descriptive and inferential statistics of Analysis of Covariance (ANCOVA), estimated marginal mean (EMM) and Scheffe post-hoc analysis. The descriptive statistics was performed to determine the students' achievement in the pretest before intervention to ensure that all the students are on the same level of achievement and posttest mean after the intervention. Analysis of Covariance (ANCOVA) was used to test the main effect of the treatment on students' posttest achievement in Basic Science controlling for pretest as covariates. The estimated marginal mean (EMM) was used to compare the students' mean achievement across the different groups, while the post-hoc test was performed to determine the source of the significant difference between the groups.

3. RESULTS

Table 1 showed the mean of the pretest scores of students in basic science prior to treatments. It showed that the students' achievement was at the same level prior to treatment.

Table 2 showed the mean of the posttest scores of students in basic science after treatment. Table 2 showed that there was an improvement in students' achievement in basic science after treatment.

The results from Tables 1 and 2 show that there were differences in the pre and posttest scores of students' achievement both in the treatments and control group. It showed that all groups had better post test scores. The tables revealed that students in the analogy group had the highest mean difference compare to the guided inquiry and modified conventional group. It could therefore be concluded that though guided inquiry and modified conventional strategies had an effect on students' achievement, the analogy instructional strategy had a higher effect on students' achievement in basic science.

$H_0$1: There is no significant main effect of treatment on students' achievement in basic science.

Table 3 showed that there was a significant main effect of treatment on students achievement scores in basic science concepts ($F_{(2,188)}$ = 13.565, $P<0.05$, partial η^2 = 0.126). The effect is 12.6%. This means that there was a significant difference in the mean post-achievement scores of students. Thus, the hypothesis was rejected. In order to determine the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups was carried out. The result is presented in Table 4.

Table 4 revealed that students in the analogy instructional strategy had the highest adjusted post-achievement mean score (12.59), followed by modified conventional instructional strategy (11.14), while guided inquiry instructional strategy had the least adjusted post-achievement mean scores (11.12). This order can be represented in AIS>MCIS>GIIS.

Table 5 reveals that students exposed to Analogy Instructional Strategy (AIS) differ statistically from their counterparts taught using both Guided Inquiry Instructional Strategy (GIIS) and Modified Conventional Instructional Strategy (MCIS) in their post achievement scores. Also, students exposed to Guided Inquiry Instructional Strategy (GIIS) were not statistically different from those exposed to Modified Conventional Instructional Strategy (MCIS), but were statistically different from those exposed to Analogy Instructional Strategy (AIS). This implies that Analogy Instructional Strategy (AIS) was the main source of significant difference in the treatment.

Table 1. Mean of students pretest score prior to treatment

Treatment	Mean	N	Std. deviation
Analogy	7.3953	86	2.04237
Guided Inquiry	6.5926	54	1.80689
Modified Conventional	7.1935	62	1.56644
Total	7.1188	202	1.86503

Table 2. Mean of students posttest score after treatment

Treatment	Mean	N	Std. Deviation
Analogy	12.7558	86	1.98782
Guided Inquiry	11.0926	54	1.48284
Modified Conventional	11.1935	62	1.60775
Total	11.8317	202	1.91651

Table 3. Summary analysis of covariance (ANCOVA) of post achievement by treatment

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	169.637[a]	13	13.049	4.314	.000	.230
Intercept	1005.486	1	1005.486	332.427	.000	.639
Pre Achievement	6.542	1	6.542	2.163	.143	.011
Treatment	82.057	2	41.029	13.565	.000	.126
Error	568.641	188	3.025			
Total	29016.000	202				
Corrected Total	738.277	201				

a. R Squared = .23 (Adjusted R Squared = .18)

Table 4. Estimated marginal means for post-achievement by treatment and control

Treatment	Mean	Std. Error	95% confidence interval	
			Lower bound	Upper bound
Analogy	12.586	.207	12.177	12.995
Guided Inquiry	11.119	.432	10.267	11.970
Modified Conventional	11.145	.235	10.681	11.610

Table 5. Scheffe post-hoc analysis of post-achievement by treatment and control group

(I) Treatment	(J) Treatment	Mean difference (I-J)	Std. Error	Sig.	95% confidence interval	
					Lower bound	Upper bound
Analogy	Guided Inquiry	1.6632*	.30289	.000	.9159	2.4105
	Modified Conventional	1.5623*	.29064	.000	.8452	2.2794
Guided Inquiry	Analogy	-1.6632*	.30289	.000	-2.4105	-.9159
	Modified Conventional	-.1010	.32472	.953	-.9021	.7002
Modified Conventional	Analogy	-1.5623*	.29064	.000	-2.2794	-.8452
	Guided Inquiry	.1010	.32472	.953	-.7002	.9021

*Where * Pairs of significantly different at P<.05*

4. SUMMARY OF FINDINGS

There was a significant main effect of treatments on students' achievement in basic science. The study revealed that Analogy Instructional Strategy (AIS) has a significant effect on students' performance in Basic Science compare to Guided Inquiry Instructional Strategy (GIIS).

5. DISCUSSION OF FINDINGS

The result of this study showed that the main effect of treatment was significant to students' achievement in basic science. The results showed that students exposed to analogy instructional strategies differed statistically on their post-achievement scores compared to those exposed to guided inquiry instructional strategies and those exposed to the modified conventional instructional strategies. Also, the result showed that students exposed to the guided inquiry instructional strategy differed statistically from those exposed to analogy instructional strategy, but were not statistically different from those exposed to modified conventional instructional strategy.

Analogy instructional strategy was found to enhance students' knowledge which in turn enhance performance, this might be due to the change in the mode of instruction that is from teacher centre (conventional method) to students' centred (analogy instructional strategy). Glynn, Taasoobshirazi and Fowler [39] believed that use of analogy instructional strategy by science teachers enhance students' understanding because knowledge is actively constructed by the learner on the grounds of constructs already available to him/her in the mind. So it is not surprising that students in this study group perform better than the two other study groups. This finding is agreement with the findings of Jiya [40] and Ayanda, Abimbola and Ahmed [41]. Ayanda, Abimbola and Ahmed [41] reported that teaching of an animal cell and biology in general with analogy based instructional strategy would facilitate, enhance and promote senior school students' learning and achievement in the subject.

The result revealed that students in the control group had a slight high post-achievement mean score compare to the students in the guided inquiry group. This might be adduced to some reasons in the course of the study which include but not limited to teachers' instructional activities, personality traits and attitude, years of teaching experience, qualifications and commitment. The teacher's academic qualifications and knowledge of subject matter, competencies and skills, and the commitment of teacher have a great impact on the teaching-learning process. Also, the reason may be due to the fact that there could be a misconception of ideas if the guided inquiry instructional strategy is not properly handled or the students are not skillfully enough to design their own investigation. This result is at variance with the work of Aniaku [42] and Olibie and Ezeoba [43] in which guided inquiry instructional strategy enhance students' academic achievement. This work is in consonance with the work of Hasan [44] who concluded that guided inquiry instructional strategy though had an effect on students' academic performance, but not in a unique way.

6. RECOMMENDATIONS

In the light of the results and discussion, the following recommendations are made: Teachers should be encouraged to adopt innovative and student-centred strategies that foster meaningful learning which in turn improve students' performance in basic science and do away with the age-long teacher-centred method that has been used for long. The Ministry of Education should organize periodic workshops and seminars to intimate the teachers with new and innovative teaching strategy. Teacher training institutions such as Colleges of Education and Faculties of Education in Universities should review the science education curriculum to inculcate/ instil in the pre-service teachers the pedagogical knowledge that will enable them to make use of the innovative strategies. Teachers should develop activities that will allow active students' participation in the teaching and learning of basic science. These are activities in which students concentrate, experience enjoyment and are provided with immediate intrinsic satisfaction that builds a foundation of interest for the future. Curriculum planners, textbook authors and teachers should endeavour to take into consideration the social environment of the students in planning learning activities.

7. CONCLUSION

Based on the findings of this study, it could be concluded that analogy instructional strategy enhanced students' achievements in basic science compare to guided inquiry and modified conventional instructional strategies. It also enhanced the students' participatory skills. Researchers and educators have made several attempts to shift from the age-long existing practice of teacher-centred method to a student-centred activity oriented method that promote meaningful learning. From the findings of the study, it could be concluded that analogy instructional strategy facilitates learning outcomes in achievement in basic science concepts (transport, respiratory and excretory systems) compare to the guided inquiry and modified conventional strategy. This strategy has inculcated into the students that basic science could be learnt through analogy instructional strategy. Thus, when students are allowed to take charge of their own learning, able to link their previous knowledge with the knowledge to be learn and couple with the right teacher characteristics, students learning of basic science will improve greatly.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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