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## Effects of Inquiry Based Science Teaching on Junior Secondary School Students' Academic Achievements: A Case Study in Hadejia Zonal Education Area of Jigawa state, Nigeria.

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### **ABSTRACT :**

This study was to ascertain the extent to which Inquiry Based Science Teaching could be effective on the Junior Secondary School students' achievement in science. Randomized experimental and control group approach was employed with a view to enabling the researcher pin down the efficacy of the Inquiry Based Science Teaching. Inquiry-Based Science Teaching Achievement Test (ISTAT) and the Students' Attitude Questionnaire on Inquiry Based Science Teaching were used as research tools. The study sample consists of 200 males and 100 females (totaling 300 subjects) junior secondary school third year students out of population of 2,873 in Hadejia zone. T-test for independent samples and Pearson Product-Moment Correlation Coefficient(r) using Statistical Package for Social Science (SPSS) were used for data analysis. The major findings include: Firstly, There is a significant difference in the achievement of experimental and the control groups in favor of experimental group showing that Inquiry-Based Science Teaching Approach is a more suitable method than the Lecture Method of teaching. Secondly, there is a significant difference in the achievement of males and females students exposed to Inquiry-Based Science Teaching Method in favor of male students. Thirdly, there is no significant difference in relationship between academic achievement in science and attitudes towards science after exposure to Inquiry-Based Science Teaching.

**Keywords:** *Science process skills, Pedagogy, Science methods, Curric*

## المستخلص :

تهدف هذه الدراسة إلى التحقق من مدى فعالية طريقة التقصي في تدريس العلوم الأساسية، واثرها في تحصيل طلاب المدارس الإعدادية الأكاديمية في مادة العلوم. تم تطبيق العينة العشوائية وطريقة المجموعة الضابطة وعرضا لكي يتمكن الباحث من معرفة كفاءة طريقة التقصي في تدريس العلوم الأساسية. تم استخدام اختبار تحصيل تدريس العلوم الأساسية بطريقة التقصي، بالإضافة إلى استبيان يتحدث عن مواقف الطلاب نحو تدريس العلوم الأساسية بالطريقة نفسها – كأدوات للبحث. تشتمل عينة الدراسة على مئتان من الذكور ومائة من الإناث (بجملة ثلاثمائة شخص) من طلاب المدارس الإعدادية – المستوى الثالث – يبلغ تعداد سكان منطقة هديجيا 2,873. تم استخدام اختبار تدريس العينات المستقلة وقد تم أيضا التحكم في درجة الارتباط عن طريق استخدام الحزمة الإحصائية للعلوم الاجتماعية، والتي تم استخدامها في عملية تحليل البيانات. شملت النتائج الأساسية الآتي: أولاً - هنالك اختلاف مهم فيما حققته تجربته والمجموعات الضابطة في تفصيل مجموعة التجربة التي توضح بأن طريقة التقصي في تدريس العلوم الأساسية هي الطريقة الأكثر ملائمة، وتفضل على طريقة المحاضرة. ثانياً - هنالك فرق مهم في تحصيل الطلاب الذكور والإناث يوضح بأن طريقة التقصي في تدريس العلوم الأساسية مفضلة للطلاب الذكور. ثالثاً - ليس هنالك فرق مهم في العلاقة بين التحصيل الأكاديمي في العلوم ومواقف الطلاب نحو العلوم بعد التعرض إلى طريقة التقصي في تدريس العلوم الأساسية. تم التوصل إلى عدد من النتائج والتوصيات في نهاية هذه الدراسة.

*الكلمات المفتاحية: المهارات العلمية العملية، علم اصول التدريس، الطرق العلمية، المنهج*

## INTRODUCTION :

Science has been a major area where students experience difficulty even though it occupies a central place in the school curricular. Such problems or failure could be greatly and effectively minimized by employing experts in the field of science with a view to ameliorating if not completely eliminating the problem. Research findings in Nigeria have indicated that the main factors that leads to poor

performance in science by students includes lack of suitable teaching methods and books, as well as scarcity of trained teachers, expansion of number of schools, the implementation of new education policy, inadequate of laboratory facilities, brain drain of science teachers or some other reasons. The above mentioned factors have contributed to a great extent to a decline of educational standard in

science. Science education in Nigeria is still far from achieving the goal of scientific inquiry and even in its best, develop competence but does not encourage inventiveness, discoveries and creativity. This is very fundamental and crucial as 1. Oyediji (1992), has attributed the students failure in science to poor pedagogical methods. For teachers, it is pertinent for them to know that a number of students in schools experienced problems in learning science. Consequently, students were not given the extra help they need to improve. Besides, quite a good number of teachers in public schools are inadequately trained and tend to employ very poor pedagogical methods.

There are several methods to class teaching but no one method provides in with all the answers. The only justifiable method is to choose the best relevance to teaching. According to this study, the solution to this problem is the Inquiry-Based Science teaching method. It is a pedagogy which best enables students to experience the processes of knowledge creation and the main outcome is learning stimulated by inquiry. It is a

student-centered approach, a move to self-directed learning, and an active approach to learning. Students should develop research skills and become life-long learners. Although research findings are not completed as to the superior effects of inquiry-based science teaching method, one can still wonder if Nigerian secondary school teachers are depriving their students the opportunity to manipulate objects or do experimental work on their own. This study is an attempt to provide Nigerian secondary school teachers with research findings as to relative effectiveness of Inquiry based science teaching techniques.

2. Ajewole (1997) suggests the need to adopt a new method that deviates in the style of teaching from the traditional approach presently being used, so that students would be able to learn more, retain more and apply what is learnt. It may be through the method of inquiry that the child will be transformed mentally, physically and intellectually. It was reasoned that some of the conceptual difficulties in understanding science concepts may likely be rooted in the type of teaching approach.

3. Wolf & Franser (2008) mention that, using an inquiry-based approach can encourage students' motivation and increase academic achievement. Inquiry-Based Science Teaching at the junior secondary schools has been found to possibly enhance student's performance, particularly as it relates to laboratory skills. 4. Lindberg (1990,) also reports that inquiry-related teaching is effective in fostering scientific literacy, understanding of scientific process skills and improves critical thinking, vocabulary knowledge and conceptual understanding. The main purpose of this study is to find out the effectiveness of inquiry-based science teaching on junior secondary school students' science academic achievement and attitudes in Jigawa state of Nigeria. Specifically, the study sought to achieve the following objectives :(1) To determine the effects of Inquiry Based Science Teaching Method in the teaching of science in JSS 3. (2) To determine the strength of the approach over other scientific methods. (3)To enumerate the process skills that can be acquired through the Inquiry Based Science Teaching. (4)Investigate

the effectiveness of Inquiry Method on the academic achievement of male and female students in the learning of science. (5) To determine the effect of Inquiry Based Science Teaching on the attitude of the students towards science.Examples of the main hypotheses of the study are : 1.1 There is no significant difference in achievement between students taught science using the Inquiry-Based Science Teaching Method and those taught the same concepts using a different approach. 1.2 There is a significant difference in achievement between students taught science using the Inquiry-Based Science Teaching Method and those taught the same concepts using a different approach. 2.1 There is no significant difference in achievement of male and female students in science taught using the Inquiry Based Science Teaching method. 2.2 There is a significant difference in achievement of male and female students in science taught using the Inquiry Based Science Teaching method.Results from this study will provide clues as to how the inquiry based science teaching approach can be

used to enhance our knowledge of best scientific methods. The study will possibly improve the quality of teaching and learning of science in Jigawa state and the nation as a whole. The study will also help the science teachers to create ways of improving the quality of teaching and learning in our secondary schools. The teachers who are directly involved are expected to give the learner opportunity to explore, utilize, manipulate his environment and becomes active participant in the lesson. As a result, students will become discoverers, inventors and innovators of new ideas as well as increase their interest in science. The study could also serve as a source of inspiration for both the government and the public for learning regardless of their socio economic background. This can minimize in the gap in the quest for our scientific and technological take off.

### **Materials and methods**

The scope of this study is not intended to cover the whole of Nigeria or even a particular region. It is limited to four junior secondary schools in Hadejia education zone in Jigawa state, Nigeria.

All the Junior Secondary Schools in the state are mixed.

The selected schools are as follows:

1. Abdulkadir Junior secondary school
2. Haruna Junior secondary school
3. Marke Junior secondary school
4. Yalo Junior secondary school

The selection of the schools was based on their proximity to each other. The study is limited to this area due to financial constraints which includes production of questionnaire, transportation, and cost of analysis of data, stationeries and equipment plus time factor. The study is expected to cover a period of two years i.e. from 2011 to 2013. The area of the study will cover Jigawa state. The state is situated in central northern part of Nigeria. Jigawa state was created out of the old Kano state in August 1991. It is one of the 36 states in Federal republic of Nigeria. Jigawa comprises of 27 local government areas. The economy of the state is largely characterized by informal sector activities, agriculture as the major economic activity.

Hadejia education zone comprises of Hadejia, Kaugama and Mallam maduri local government areas all under Hadejia emirate. Hadejia is a Hausa/Fulani town in eastern Jigawa state. The population was about 110,357. The town lies to the north of the Hadejia River and upstream from the Hadejia Nguru wetlands.

#### • **Methods of the study**

Descriptive and analytical approach was adopted. Pretest, posttest, experimental and control group design was used for this study. The population for the study comprised of all JSS 3 students in Hadejia education zone of Jigawa state which is 2,873. A total of three hundred (300) JSS students drawn from four selected schools constituted the sample which represented the respective selected schools depending on the school population. The number of students from each school is as follows:

- a. Abdulkadir Junior secondary school Dallah-120 students
- b. Haruna Junior secondary school – 120 students
- c. Marke Junior secondary school - 30 students

d. Yalo Junior secondary school - 30 students

Two instruments were used for data collection in this study: These are;

#### a. **Inquiry- based Science Teaching Achievement Test [ISTAT]**

The ISTAT has to do with the measuring of students' competence in science. The purpose of ISTAT is to find out how the students can cope with the study. The test will be administered to both experimental group after exposure to the treatment (inquiry- based science teaching) and the control group who were exposed to treatment different from that of the experiment group (i.e. lecture method by the teacher).

#### b. **Students Attitude Questionnaire on the Inquiry Based Science Teaching [SAQIST].**

The questionnaire is expected to investigate the student's attitudes towards science and examined their science needs. The statements in SAQIST are structured on a five point Likert scale of Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). The SAQIST was administered to the experimental groups only.

## Procedure

A test consisting of 30 objective items drawn from general science, specifically from the past question papers of science placement examinations and the integrated science for junior secondary schools text books 1-3 was administered to the subjects. The items in the test constructed were administered in order to determine the level of the experimental and control groups. The groups were taught Basic Science for six weeks. The answer scripts of the test taken were collected, marked and

compiled by the researcher. Students Attitude Questionnaire on Inquiry Science Teaching (SAQIST) was administered to the experimental group only and the forms were graded and compiled by the researcher and the result of the two instruments formed the data for this study.

### • Results:

Descriptive and inferential techniques were used for the data analysis. The data collected were analyzed and discussed in relation to the null and alternate hypotheses.

**Table (4.1): Independent samples t-test for difference between Experimental & Control groups after treatment.**

<i>Group</i>	<i>No. of student</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>t-value</i>	<i>P-value</i>
<i>Experimental</i>	<i>101</i>	<i>18.770</i>	<i>52.65</i>	<i>10.51</i>	<i>0.000</i>
<i>Control</i>	<i>101</i>	<i>315.13</i>	<i>2.16</i>		

From the above table, it shows that the P-value of t-test (.000) is less than significant level (0.05) which means that the students in the experimental group who were taught using Inquiry-Based Science Teaching were significantly

different in their performance from their counter parts in the control group. The mean score of the experimental (18.70) was significantly higher than that of control group (15.13).

**Table (4.2): Independent samples t-test for difference in performance between male & female students in experimental group after treatment.**

<i>Group</i>	<i>No. of student</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>t-value</i>	<i>P-value</i>
<i>Male</i>	<i>60</i>	<i>18.90</i>	<i>2.23</i>	<i>2.687</i>	<i>0.008</i>
<i>Female</i>	<i>52</i>	<i>17.83</i>	<i>1.98</i>		

From the above table, it shows the mean scores and standard deviation for males and females (18.90, 2.23), (17.83, 1.98) respectively. Also the P-value of t-test (.008) is less than significant level (0.05) which means there is statistical difference between male & female scores in favor of males.

**Table (4.3): Significance of Correlations between Experimental group Inquiry-based Science Teaching Achievement Test( ISTAT) scores/30% & Experimental group Students Attitudes Questionnaire on Inquiry-Based Science Teaching (SAQIST) scores/15%**

		<i>Experimental group ISTAT scores/30</i>	<i>Experimental group students attitudes questionnaire (SAQIST) scores/15</i>
<i>Experimental group ISTAT scores/30</i>	<i>Pearson Correlation</i>	<i>1</i>	<i>0.110</i>
	<i>P-value</i>	<i>-</i>	<i>0.403</i>
	<i>N</i>	<i>150</i>	<i>150</i>
<i>Experimental group students attitudes questionnaire (SAQIST) scores/15</i>	<i>Pearson Correlation</i>	<i>0.110</i>	<i>1</i>
	<i>P-value</i>	<i>0.403</i>	<i>-</i>
	<i>N</i>	<i>150</i>	<i>150</i>

Source: From applied study, SPSS Package, 2013



The table above (4.3) has shown the P-value significant of correlation (.403) is greater than significant level (0.05) that means there is no significant difference between students' attitudes taught science using inquiry based science teaching and their academic performance, but there is a weak correlation of (0.11).

**Table (4-4): Independent Samples t-test for difference in academic performance between males & females in control group**

<i>Group</i>	<i>No. of student</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>t-value</i>	<i>P-value</i>
<i>Male</i>	<i>60</i>	<i>15.32</i>	<i>1.94</i>	<i>-1.320</i>	<i>0.190</i>
<i>Female</i>	<i>50</i>	<i>15.76</i>	<i>1.49</i>		

The above table shows that the P-value of t-test (.190) is greater than significant level (0.05) that means there is no

#### **DISCUSSION :**

The intent of this study is to investigate effects of Inquiry-Based Science Teaching Method on the academic achievement and attitudes of Junior Secondary Schools in Hadejia Zonal Education Area of Jigawa State, Nigeria. To achieve this aim, subjects in the experimental group were taught science topics using Inquiry-Based Science Teaching Method while their counter parts in the control group were exposed to the same topics using traditional method. The subjects in the experimental and control groups were post-tested and the scores were analyzed to test the hypotheses. Eight hypotheses were stated

statistical difference between male & female in scores.

and tested based on the scores from the Inquiry-Based Science Teaching Achievement Test (ISTAT) and Students' Attitudes Questionnaire on Inquiry-Based Science Teaching (SAQIST). The subjects in the experimental and control group were post-tested. Data analysis obtained was presented in tables 4.1-4.4. The students in the experimental group improved significantly as a result of Inquiry-Based Science teaching method used to teach them. The finding is in agreement with that of 5. Adegive (2000) who reported that teacher's methodology favors learning, initiative and curiosity and

thereby making reliance beyond increasing students' outcomes. The possible reason for this may be the group interaction in practical activities, unlike the lecture method which does not permit active participation of learners and it is largely not suitable for teaching science concepts. This result reveals the finding of 6. Walberg (1991) that activity-based science teaching featuring active participation in learning produced superior learning results. 7. Nwosu (2001) discovered that exposure to science based problem solving activities for both male and females yield more positive and more effective learning irrespective of gender and ability levels. However, the sex variable which was the focus of second hypothesis revealed significant trends. The Inquiry-based science method is therefore, found to be more-effective to males than females. Gender is therefore, a factor in the benefit derived from the method. The result agrees with earlier reports of that male and female students did not achieve equal competence in science and mathematics. 8. Shuaibu (1982) also reported that boys perform better in

science than girls. 9. Tamir (1985) reported that boys were more interested in physical sciences while girls preferred biological sciences. It was observed that a significant superior achievement of boys over girls in integrated science at the junior secondary level. These differences in achievement between boys and girls may be due to the varying tasks performed by boys and girls in their early years and therefore are insignificant. He went further to explain that severe limitations on young females in the performance of science process skills at the schools may have an effect on the ease with which they learnt science and consequently the reluctance of the majority of female to actively engage in science and related courses. It was reported that gender differences in science achievements occurs as a result of a number of factors both at home and at school and that gender differences appear to be greater in some schools than in others. Although statistically significant gender differences in science achievement were also found among year-12 chemistry students favoring boys. There were statistically significant

sex differences in physics achievement among students from all age groups, however, both male and female students appeared to achieve higher physics scores to more advantaged home background. The difference may be due to cultural and religious factors because the girls are mostly restricted from exploring the experiment. This finding is contrary to what observed in other experiments in the past that when girls are given equal opportunity to participate in science activities and to manipulate objects in teaching and learning, they excel as well as boys. However, a study conducted by **10. Ameh(1980)** to determine the influence of sex upon the acquisition of science skills, revealed that boys were better at using numbers, measuring and experimenting than girls while girls perform better in the process of observation. This finding is also in line with **11. Roberts(1987)** who conducted a research in Scotland with Junior secondary schools students aged 15-16years and discovered boys performed better in science but the girls were better at focusing of microscope than boys.

The values in table **4.3** indicate that there is no significant difference in relationship between the student's attitude and academic achievement, but the correlation is weak(0.11). However, this may be attributed to the short period during which the teaching and the practical work given to the teachers who took care of the experimental group. With all that the SAQIST scores was very high. This statistical finding is in line with that of **12. Akinmade (1986)** who found a significant relationship between a child's attitude and his cognitive achievement. It was also found that improvement in science achievement was dependent on improved attitudes towards science. The result shows that there is no significant difference in the performance of females as well as males when exposed to science concept using the lecture method. Females performed as well as males in their performance. This finding is similar to that of **13. Akpan(1992)**, who reported that both male and female benefited almost equally from lecture and demonstration methods. There is a need to further this

and similar stud that could be conducted in Private and Federal schools including the senior secondary schools and tertiary institutions to see the effectiveness of the Inquiry-based science teaching method.

### CONCLUSIONS :

Conclusively, results from this study certify the use of Inquiry-based science teaching as a teaching method that could be used to facilitate learning science in JSS level.

1. Teaching methods that teachers employ in science teaching have significant effects on students' academic achievement even though the males performed better than the females

2. Neither the males nor the females students perform significantly better than the other when science topics were taught to them using the lecture method of teaching and generally

3. Students show positive attitudes towards science when motivated by the teachers.

### Recommendations

Arising from findings of this study the following recommendations were suggested:

1. Since Inquiry-Based Science Teaching is found to enhance or improve student's performance in science, teachers should be encouraged to teach science using Inquiry-Based Science Teaching Method in Nigerian schools.

2. Positive attitudes towards science should be encouraged and developed in the junior secondary school students. This is very essential as some students experience difficulties in learning science arising from unfavorable attitudes towards the subject. The role of motivation therefore is important.

3. Regular on-the-job trainings, workshops, seminars, symposia and conferences should be organized at intervals for the teachers in Junior and even secondary schools to update their knowledge on the application of Inquiry-Based Science Teaching Method. This will also make the teachers to become more conversant with new methods, new discoveries and techniques on how to handle students experiencing problems in learning science.

4. Data analysis in table 4.2 indicates that female students did not gain as much as their male counterparts in the use of Inquiry-Based Science Teaching. Based on this, it is recommended that the state government in collaboration with Girls Child Education Program provide educational environments that support females to benefit from Inquiry-Based Science Teaching.

5. Schools should give teachers opportunity and create an enabling environment for effective teaching in science to ensure all students opportunities for effective learning.

6. Gender stereotype should be discouraged. Both at home, the school and the society should encourage the males and females.

7. The National and States Universal Basic Education Board(SUBEB) and the Education Sector Support Program in Nigeria(ESSPIN) should give emphasis on conducting science teachers training programs especially on this type of modern techniques.

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