Research Article

Impact of Activity-Based Teaching Strategy on Gifted Students: A Case of Selected Junior Secondary Schools in Nigeria

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Abstract

The study investigates the impact of activity-based teaching strategy on gifted students' academic performance. Quantitative methods using a quasi-experimental design were used on a random sample of 330 gifted students selected from 11 junior secondary schools from Katsina Metropolis, Nigeria. A 60 items Basic Science Achievement Test (BSAT) with reliability coefficient of 0.98 was administered to 11 schools before and after the treatment and scores analyzed using t-tests. The findings revealed significant differences in the academic performance between the experimental group exposed to the activity-based teaching strategy when compared to the control group exposed to the traditional lecture method. These findings recommend schools to adopt the activity-based teaching strategy in science classroom in order to effectively commit student to mastery of the subject in both practical and theoretical terms.

Keywords:

activity-based teaching strategy, gifted students, pedagogy, performance

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Introduction

Over the years, researchers and other stakeholders in the spheres of education have been debating about different approaches to science teaching and learning. Central to this debate is the concern about students' performance in science. Tannenbaum (2003) describes it as "the performance which comes out of the abilities". Many research studies have reported the poor performance of students in science (e.g., Clark, 2002; Mokiwa, 2014, Mudau, Mundalamo, & Sedumedi, 2014; Usman, 2000) with some attributing this problem to the classroom pedagogy of science (e.g., Dahiru, 2010; Garba, 2012; Olatoye & Agbatoyun, 2014).

In Nigeria, for instance; Garba (2012) contends that after the "Sputnik Era" of the 1950's and 1960's, the attention of scientists and science educators shifted to bring about reformation in science teaching and learning. Discoveries relating to the reformation of science instruction and the discovery strategies in the teaching of science in schools were emphasized. This shift increased the scope of science teaching and learning, especially in the developing countries, including Nigeria (Usman, 2000). The National Policy on Education (2004) endorses innovative teaching strategies for curriculum delivery. As such, many researchers (e.g., Clark, 2002; Marley & Carbonneau, 2014; Usman, 2000), are of the view that the activity-based method of teaching enhanced gifted students' academic performance generally. In Nigeria, the term "giftedness" is associated with students' ability to display superior performance in a specific learning area compared to their peers with respect to creativity or intelligence. This is to say, students differ in terms of the pace and amount of information they process. An understanding of such qualities amongst students enables the teacher to create conducing learning environment that will help them improve those abilities.

Activity-based teaching strategy (ABTS) is a technique whereby the main focus is learning by doing (Carbonneau & Marley, 2012). Since learning involves physical and mental actions that stimulates creative action and expression, gifted students would need distinct conditions to advance their extreme curiosity, tacit thoughts and potentials arising from their abilities; for instance, creative problem solving (Kontaş, 2009). These researchers argue that the use of activity-based learning methods seek to address some major problems of the traditional method of teaching hence; the need to bring about a paradigm shift in some key classroom processes, such as the role of teachers, instructional materials and methods. They further contends that: (a) provision of opportunities for measuring gifted students' learning through experience, direct observation and participation; (b) fostering the enhancement of the quality of primary education generally as a vital element to improving science/teaching methods in schools; (c) enabling learners to acquire numerous benefits that include a development of their insights and understanding and the up-scaling of self-concepts; (d) improving gifted students' opportunities for learning

science through changing the traditional roles of the teacher and the learners; (e) creating opportunities for gifted students to take charge of their own learning and work at their own pace, achieving the desired goals at their own ladder and (f) enabling gifted students to be grounded on the view that they must necessarily be engaged through actions and activities to learn effectively.

This study therefore constitutes an attempt to fill the gaps in the use of traditional methods in science teaching to gifted students. The paradigm shift from teaching to an emphasis on learning is to encourage power to be moved from the teacher to the student (Mokiwa, 2014). This development is in contrast to the traditional forms of teaching in which a teacher lectures and relays information to students who are expected to absorb what they are told. Alao (2010) contends that teachers of science ought to know about specific standards which determines the selection of approaches leading to effective learning. In activity-based learning, the teacher serves the function of a facilitator, assisting gifted students through the learning process and providing them with guidance (Marley & Carbonneau, 2014), where group work is quite common during activity-based learning. It allows gifted students to take a leading role in learning and work together to better understand different concepts of the subject matter. Under these circumstances, gifted students work together in small groups to accomplish particular project tasks.

Statement of Problem

The performance records of gifted students in basic science for the past decades shows that Nigeria has displayed less than a 45 per cent credit pass in public examinations (e.g., Okebukola & Jegede, 1998; Moja, 2000). Empirical evidence clearly indicated low performance in science in most Nigerian secondary schools. This scenario derives from students' inability to comprehend what is entailed in using laboratory effectively, and teachers' inability to achieve effectiveness in curriculum delivery as a result of lack of in-depth knowledge of science in totality (e.g., Akinfe, Olofinniyi, & Fashiku, 2012; Jegede & Okebukola, 1998; Jita, Ndlalane, & Maree, 2008; Lederman & Abell, 2014; Mokiwa, 2017).

Most science teachers in Nigeria use the lecture method when teaching (e.g., Ayodele, 2010; Nwosu, 2004; Opatoye, 2010). However, lecture method has been found to be ineffective in science instructions (e.g., Akinsola & Igwe, 2002; Bichi, 2006; Muhammad, 2007). Thus, it is apparent that problems exist in the teaching and learning of science. These problem essentially hinge on the use and exploration of requisite methods, including the activity-based teaching in determining the extent to which they enhance gifted students' academic performance in science at junior secondary schools in Katsina Metropolis, Nigeria. This situation has necessitated the need to find out the reasons behind this development. Therefore, our study aims to investigate whether the use of an activity-based instruction method could enhance

gifted students' academic performance in science at the junior secondary school level.

Considering the slow progress and status of technological development in Katsina State of Nigeria, it has become necessary to re-assess the strategies employed in teaching science and technology to future generations in order to determine their efficacy and worthwhileness. The current rate of failure, especially in science subjects shows a serious and fundamental flaw in the background knowledge amongst gifted students in sciences. Since the purpose of the study is to compare the academic performance of gifted students taught using activity-based methods and those taught using the lecture method; the following research question guided the study:

- What is the difference between the academic performance of gifted students taught using activity-based teaching methods and those taught using the lecture method?

As well, the following research hypothesis was formulated to guide the study:

$H0_1$: There is no significant difference between the academic performance of students taught science concepts using activity-based teaching methods and those taught using the lecture method at the junior secondary school level.

Method

Our study constituted a quasi-experimental research design, where the pre-test, post-test experimental and control group was used. At the beginning, a pre-test was administered to solicit gifted students' entry behavior. After this testing, we exposed the experimental group to the treatment by teaching them using the activity-based method after which a test (post) was administered to them. This treatment was not done with the control group that was given the same instructions as the experimental group using the traditional lecture method. Then, the teaching of both groups i.e. experimental and control was done by the researchers and post-test was administered to the two groups at the end of the treatment.

Symbolically, the research design of the study may be represented as:

E1 ⟶ O1 ⟶ X1 ⟶ O2

C2 ⟶ O1 ⟶ X2 ⟶ O2

Where;   E1 = Experimental group

                 C2 = Control group

                 X1 = Activity-based method

                 X2 = Traditional lecture method

                 O1 = Pre-test
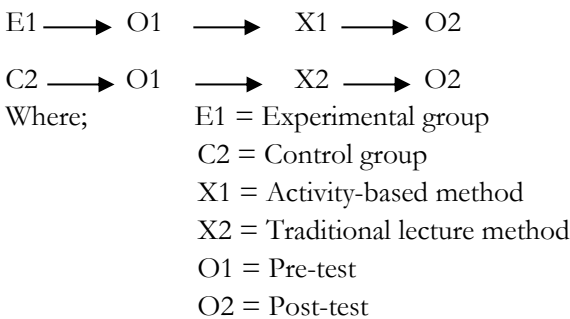
                 O2 = Post-test

Figure 1
Research Design

Participants

The study population comprise of all the junior secondary three (JSS III) students located in Katsina Metropolis. Katsina Metropolis is classified into three zones, namely; Zones A, B, and C. Table 1 below shows the eleven junior secondary schools (i.e. S1 to S11) with a student population of 9006 studying Basic Science that were considered effectively functional in this study. The basis for the classification of the schools derives from their respective locations in a homogeneous urban environment of Katsina Metropolis. This is to say all schools were grouped in a particular zone basing on their shared social economic status. This was deemed important for obtaining rich data from the participants.

Table 1
List of Eleven Junior Secondary School III (JSS III) in Katsina Metropolis

Name of Schools	Number of students	Zone
S1	1120	B
S2	2218	A
S3	550	C
S4	492	C
S5	334	A
S6	524	C
S7	505	C
S8	1287	B
S9	540	A
S10	86	B
S11	1350	B
TOTAL	9006	

Source*: Department of Planning, Research and Statistics, Ministry of Education, Katsina, Katsina State (2014).*

Sample Size and Sampling Procedure

Eleven junior secondary schools from the three zones of the study consisting of 9006 students represented the target population. A sample of three junior secondary schools were randomly selected from the eleven schools in the entire three zones (i.e. one school was selected from each of the three zones).

Random sampling technique was used for selecting the respondents. In this process of building the sample population. Gray (1980) recommends that percentages ranging from 10% to 15% and 20% could be used to select a sample size from given population of over 5000. Through this procedure, it was envisaged that a sampled population of about 400 students could be raised for the study. Thus each of the sampled school in the three zones of the study was constituted into a sampled population ranging between 100 to about 130. The population organized for any of

the schools represented in each of the three zones was split into two to constitute the experimental and control groups that presented in the study. These two groups were sorted out into classes of 55 students respectively in each of the three zones of the study.

Data collection

The research instrument for the study titled "Basic Science Achievement Test" (BSAT) comprised of 60 multiple choice items generated from National *Examination Council for Basic Education Certificate Examinations* for Junior Secondary School Certificate. These instrument and assessment items are available at the Ministry of Education Katsina, Katsina State, Nigeria and were adopted for the study. The items were deemed to have met a number of measurement criteria estimated by experts and experienced science teachers in our secondary schools. These National Examination Council (NECO) test items met the following perquisites, namely:

(a)   They have earned the recommendations of a variety of academics and scholar judges;
(b)   They possess appropriate difficulty indices in the range of 0.30 to 0.07
(c)   The instrument reflects the 4 cognitive levels of Bloom's Taxonomy in the Cognitive Domain (Bloom, 1986).

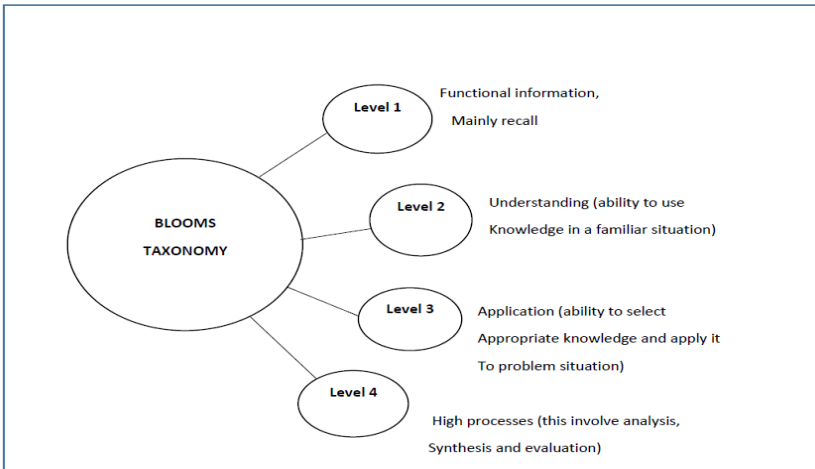These four levels are illustrated by figure 1 below.

Figure 2
Blooms Taxonomy Cognitive Levels

The 60-item test instrument BSAT was adopted and distributed according to the foregoing levels (Bloom, 1986) as follows:
25 questions for Level A.
15 questions for Level B.

15 questions for Level C.

5 questions for Level D.

The adoption of the instrument's test items was made following a thorough consultation with science lecturers from Science Departments in the two universities in the vicinity of Katsina Metropolis. The researchers also consulted secondary school science teachers because of their vast experience. These teachers contributed in making the research instrument for the study.

In order to remove possible teacher bias, the researchers conducted the teaching of both the experimental and control groups by themselves, while adhering to the prepared lesson plans. The contact sessions for both groups took nine weeks. The first week was used for the pre-test before the commencement of the experiment to determine the equivalence of the two groups. The second week up to the seventh week were used for the teaching of both groups. The eighth week was used for post-testing both groups.

The experimental group was taught using a variety of instructional materials and resources including drawing materials and equipment, cardboard drawings, diagrams, pictures, photographs and various forms of visual materials. These treatment materials were not used with the control group which received the same instructions as the experimental group taught through lecture method. At the end of the treatment, we administered a post-test.

Administration of Research Instrument/Treatment

The treatment administered to the subjects involved teaching the following basic science concepts namely: (a) erosion; (b) pollution; (c) deforestation; (d) flooding; (e) desertification and bush burning and (f) ozone layer depletion. Two pedagogical methods were used for administration, namely: (a) Activity-Based Teaching Strategy; and (b) Traditional Teacher-Centered Method.

Lesson plans were already prepared for teaching the foregoing concepts. The ABTS was based, among others, on the theory of constructivism which capitalizes on learning by doing. The researchers adopted the "5E" model of ABTS developed by Bybee, Taylor, Gardner, Scoter, Power, West brook and Landes (2006). The model has five phases which include: "engage", "explore", "explain", "elaborate", and "evaluate". The first phase (engage) involves the employment of activities that mentally engage students with an event or questions. Engagement in activities induced students to make connections with what they know and can do. Students were made to commit themselves to use their prior knowledge in order to understand and master new concepts.

In the second phase (explore) students were committed to work with one another to explore ideas through hand-on activities in the classroom/laboratory. This exploration stage provided a set of common experiences for all gifted students.

Students learnt many skills such as making observations while performing classroom activities; they cooperated with their mates to execute some skills; they entertained respect for others' viewpoints; they demonstrated tolerance for colleagues in such activities as data collection and date evaluation. In this phase the teacher's role was focused on guiding students.

In the third stage gifted students were engaged in a variety of classroom activities; they constructed and explained a variety of concepts learnt. In the fourth phase students were made to apply what they already learned in new situations, new topics and concepts. The last phase bears on evaluation; where students were able to assess their understandings, strengths and abilities and provided them with the opportunity for interaction with their teacher and fellow students. At this stage, the teacher also evaluated the progress made by students.

In each of the 3 zones covered in the study; gifted students (the experimental groups) were sub-divided into small group of six to seven students. This made it possible for students to be involved in interactive classroom operations. In reference to gifted students in the control groups, they were taught through traditional method, that is, the "talk and chalk" method with little or no activities deriving from students. Treatment administration for both groups of students lasted for about seven weeks. Five-double periods of 80 minutes were used respectively in the whole exercise. During the last week, we administered a post-test to the two groups.

The researchers administered the instruments to the students through face to face contact with the help of research assistants and a number of classroom teachers. Pre-test was administered at the first instance to determine equivalence of the experimental and control groups. After treatment, post-test was administered to both groups. The necessary instructions required for a smooth completion of the tests were clearly stated and explained. Personal information such as class registers, names of schools and gender difference were requested and these were clearly stated, explained and supplied. After the treatment, both experimental and control groups were subjected to 60-item BSAT. The results obtained from the tests were used to provide answers research question and test the study hypothesis.

Data Analysis
The results of the BSAT were analyzed quantitatively; in which each correct answer was scored 1 mark with a maximum of 60 marks. The scores obtained from the BSAT provided answers to the research questions and test the study hypothesis. The research question was answered using means and standard deviations while the hypothesis was tested using t-test statistics of independent samples at 0.05 significance level.

Results

With regards to research question "What is the difference between the academic performance of gifted students taught using activity-based method and those taught using lecture method?" the post-test scores collected from the two groups (experimental and control) were analyzed and presented in Table 2 below.

Table 2

Comparison of Mean Values of Academic Performance of Experimental Group versus that of Control Group

Groups	N	Mean (x)	Standard Deviation	Standard Error Mean
Experimental	165	43.91	4.90497	.38185
Control	165	39.82	2.40242	.18703

Table 1 shows a mean difference of 4.09 in the post-test scores of the two groups. The experimental group recorded higher academic performance in her mean score of 43.91 than her control group counterpart with a mean academic performance of 39.82. This result implies that gifted science students taught using Activity-Based Teaching method achieved higher dividends than those exposed to traditional lecture method. The standard deviations of the two groups are respectively put at 4.90497 and 2.40242.

Regarding the research Hypothesis:

$H0_1$: *There is no significant difference in the academic performance of gifted students taught basic science concepts using activity-based teaching strategy and those taught using traditional lecture method.*

This hypothesis was tested with data collected from the academic performance records (post-test) of the two groups of gifted science students (experimental and control). T-test independent sample statistics was used in comparing the performance of students in the control and experimental groups at 0.05 confidence level. A summary of the finding is tabulated in Table 3.

Table 3

T-test Analysis of Difference in the Academic Performance of Experimental and Control Groups

Groups	N	Mean (x)	Standard Deviation	df	t	P	Decision
Experimental	165	43.91	4.90497	328	9.621	.000	Sig.
Control	165	39.82	2.40242				

Table 3 displays that t-value = 9.62; df = 328 while p –value = 0.000. Since the p –value (0.000) is less than the alpha value (.05), therefore the null hypothesis is rejected and the alternate hypothesis is adopted. Thus it is concluded that there is a significant difference in performance between experimental and control groups. This difference is in favor of the experimental group. This shows that those gifted science students taught using ABTS tended to achieve significantly higher than those gifted science students taught using traditional lecture method. Hence the above hypothesis was rejected.

Discussion and Conclusion

This study was conducted with the purpose to compare the academic performance of gifted students taught using activity-based methods and those taught using the lecture method. Study findings showed the significant academic performance difference found amongst the two groups of learners, was due to the use of activity-based teaching method as a pedagogical strategy for the experiment group. Since the experimental group performed significantly higher than their counterparts, there is an implication that the use of activity-based teaching strategy is very effective in teaching and learning of basic science at junior secondary schools. These findings are in line with various studies in this research area. For example, Binta's (2014) study that found that the academic performance of students exposed to lecture method of instruction was lower than that of those who were exposed to cooperative teaching strategy.

These results are similar to Choo's (2007) study in relation to outcomes, suggesting that exposing students to authentic learning with an appropriate amount of support could have a positive impact on student achievement. Not only that, but also it was evident that overall, 90.4% of the participants agreed that they have enjoyed learning with the activity-based lessons. The study further found that the activity-based teaching strategy was conceived to prepare students to be independent learners.

Similarly, Azuka (2013) in her study of activity-based learning strategies in Mathematics classrooms found that students understood Mathematics concepts and registered higher retention rates where they actively participated in lessons. She

stressed that teachers should move away from the "telling method" and select strategies which will promote active learning in the classrooms. In her research reports on "the effects of activity-based instructional strategy and traditional method" on the academic performance of students in Integrated Science in Junior Secondary Schools in Kaduna (Nigeria).

On the contrary, Losardo and Bricker's (1994) comparison study, found no difference in the effects of activity-based intervention and direct instruction or lecture method. However, they found slightly better maintaining of skills taught using embedded direct instruction than activity-based intervention. Their findings are contrary to the findings of this study which evidence ABST brings about positive impact on gifted students' academic performance.

As the ABTS endorses "learner-centeredness", the experimental group students were urged to explore the assets intrinsic in this pedagogical design in registering a higher ability in learning basic science concepts in secondary schools. These students were oriented at committing themselves to the assets in the "constructivist theory" which lays emphasis on learning by doing (Vygotsky, 1978). The constructivist learning is particularly suited for scientific knowledge. The employment of the ABTS endorses the need of subdividing students into small groups of five or six, this design is tailored at committing students in any given lesson. The components enshrined in the ABTS are tailored at enhancing mastery of learned concepts and resources.

Basing on the study findings, the following conclusions were made:

➢ The use of the activity based-teaching methodology brings about positive impact on gifted students' academic performance/achievement towards studying and learning basic science in junior secondary schools.

➢ There is significant difference in the post-test mean scores obtained by gifted students taught basic science using activity-based methodology, as compared to their counterparts who were taught the same content structures using the traditional teacher-centered methodology.

➢ The students exposed to the activity based teaching strategy registered higher mean scores towards studying and learning basic science concepts. Thus the learner components and commitments intrinsic in activity-based teaching methodology are more effective in fostering mastery learning of basic science and therefore engendering the enhancement of gifted students' retention ability indices in the subject.

Recommendations

Basing on their findings, the researchers recommends the following:

➢ Schools to adopt the activity-based teaching strategy (pedagogy) in science classroom in order to effectively commit student to mastery of the subject in both practical and theoretical terms;

> ➤ Science teachers should be provided with in-service trainings to acquaint them with knowledge and skills of activity-based teaching methodology;
> ➤ All stakeholders should work together so as to afford teachers implement activity-based teaching strategy in schools.

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