Research Article

The Impact of Context-based Instructional Approach on Students Academic Achievement and Retention of Hydrocarbon Concepts among Science Secondary Students in Kano State, Nigeria

Suwaiba Said Ahmad

Department of Science and Technology Education Bayero University Kano, Gwarzo Road, Kano State 7006, Nigeria

Corresponding author: suwaibatu@yahoo.com

Abstract

This study investigated the Impact of Context-Based Instructional Approach on Students Academic Achievement and Retention of Hydrocarbon Concepts among Science Secondary Students in Kano State, Nigeria. The population of the study comprised 6 Science Secondary School in Kano State; stratified random sampling was used to identify the sample. The sample of the study comprised 120 SS 2 students made up of 60 males and 60 females. The research design adopted for this study was pre-test-post test quasi experimental control group design. The Experimental group was exposed to context-based approach while the control group was taught using lecture method of instruction. One instrument was developed and used for the study, Chemistry Achievement Test (CAT). The reliability coefficients of the instrument is 0.85 using split half method Three null Hypotheses were tested using t-test at a significant level of p<0.05. The major finding from the study included: There is significant difference between the academic achievement of students exposed to Context-Based Approach and those Exposed to Lecture method in favour of the experimental group. It was concluded that Context-Based Approach improves the achievement of chemistry students. Based on the findings, it was recommended that Context-Based Approach be used as a method of instruction for both gender, having been established to improve the performance of both male and female students. Teachers should be encouraged to use less of lecture method.

1. Introduction

Science and technology have been recognized worldwide as being the key factor in development. Therefore, the learning and understanding of science is imperative. This is supported by Abdullahi (1997) who argued that the development of any society depends on its scientific and technological achievements. Science and technology have become critical factors of economic and social development as it is through
their application that the natural resources of the country could be transformed into goods and services for better quality of life for the majority of the country’s citizens. The economic development of a nation is dependent, to a large extent, on the advancement of its science and application (technology).

Nigeria is a country that its economy is dependent on the industrialized nations because they have not adequately applied science to exploit their natural resources (Abdullahi, 1997). Nigeria is unable to apply science because science education in the country is faced with so many problems.

At the secondary school level, science education faces a lot of problems. Research reports in Nigeria indicate that students achieve poorly in secondary school science subjects (Ogbonnia, 1999; Nwagbo, 2002). A number of factors were identified as militating against students’ attainment of the objectives of science instruction. The isolated factors among researchers are the inappropriate and uninspiring teaching approaches adopted by science teachers (Onwu, 1993; Ogbonnia, 1999; Nwagbo, 2002). These researchers express the view that teachers shy away from teaching approaches which are known to be more effective in providing cognitive gains and acquisition of science skills. They rely most on teaching approaches that are easy but most times inadequate and inappropriate. Abdullahi, 1997 and Nwagbo, 2002 reported that the use of poor approach to science teaching in Nigeria has made it difficult to develop a high scientifically literate society. She argued that the use of appropriate teaching strategy will enhance achievement and promote scientific literate society.

Available pieces of evidence from West African Examination Council (WAEC) indicate that students’ academic performance in chemistry, especially at the senior secondary School level worsens as years go by and many students seem to have negative attitude towards the subject (Oyedegi, 1992; Betakin, 2002. Research evidence (Onwu, 1993; Ogbonnia, 1999) have shown that students generally have difficulty in understanding chemistry and this perhaps accounts for their consistent poor academic performance in the subject in senior school certificate examinations. The situation has been partly blamed on teacher’s persistent use of traditional teaching methods.

New teaching approaches are being developed, among which is context-based approach (Pilling, Holman and Waddington, 2001; Parchmann et al., 2006; Pilot and Bulte, 2006). Context – Based approach according to King (2007) refers to teaching episodes where the application of chemistry to a real – world situation is central to the teaching of chemistry. In such a way, the chemistry is taught when the students require the knowledge for the further understanding of the real – world application (King, (12007). An instructional frame work that prioritizes learning through students inquiries therefore should embody a “need – to – know” principle where the context legitimizes the learning of chemical theory from the
perspective of the students and thus makes their learning both intrinsically and extrinsically meaningful (Beasley & Butler, 2002).

Thus, the function of context is to describe such circumstances that give meaning to words, phrases and sentences (Gilbert, 2006). In other words, a context must provide a coherent structural meaning for something new that is set within a broader perspective. These descriptions are consistent with the function of the use of contexts in chemistry education. Students should be able to provide meaning to the learning of chemistry. They should experience their learning as relevant to some aspect of their lives and be able to construct coherent “mental maps” of the subject (Gilbert, 2006).

Context-based approach has been shown to increase positive attitude to science. Girls in classes using a context-based approach held significantly more positive attitude to science than their peers in classes using traditional approach (Ried and Skryabina, 2003). A context-based approach to teaching science narrowed the gap between boys and girls in their attitude to science (Ramsden, 1992; Ebenezer and Zoller, 1993). Thus, the present study intends to explore whether gender is still a factor in achievement in chemistry and whether context-based approach is gender bias or not i.e. whether it provide equal opportunity for both sex to learn chemistry at the same rate and equally well.

Retention which is a variable of the present study has been defined by Bichi (2002) as the ability to retain and consequently remember things experienced or learned by an individual at a later time. Akinbobola and Folashade (2007) argued that when teaching is characterized by rote learning and meaningless memorizing on verbalism, students make ineffective learning, and the facts thus learned are not long retained, nor do they seem to have much effect in changing behaviour. Students must retain information from classes in order to benefit from the learning. The amount of retention will be directly affected by the degree of original learning (Lieb, (1991). Schmidt and Bjork (1992) argue that learning is an imperfect indicator of later performance, and that learning and retention, therefore, should be considered together. It is therefore important to understand how acquired knowledge and skill are retained and should be maintained in the longer term. Hence for retention to be effective individual must see a meaning or purpose for that information and context-based approach provide opportunity for students to see the meaning and establish a link for concepts learned. When learning is made more meaningful concepts are better organized and retention is improved. The study is posed to find if context-based approach has effect on retention of learned concepts.

Many research studies have shown poor performance in chemistry (Nwagbo, (2002) & Abdullahi, (1997). WAEC statistics 2007-2011 as shown in Table 1 indicate high rate of failure in chemistry.
Table 1 Performance of Students in Chemistry at SSCE Level (WAEC) in Kano State, from 2007-2011.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NO. OF STUDENTS PRESENT</th>
<th>NO OF STUDENTS PASS AT CREDIT LEVEL</th>
<th>NO OF STUDENTS WITH P7-F9</th>
<th>% PASS WITH CREDIT</th>
<th>% WITHOUT CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>3810</td>
<td>680</td>
<td>3130</td>
<td>18</td>
<td>82</td>
</tr>
<tr>
<td>2008</td>
<td>4060</td>
<td>806</td>
<td>3254</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>2009</td>
<td>4420</td>
<td>802</td>
<td>3618</td>
<td>18</td>
<td>82</td>
</tr>
<tr>
<td>2010</td>
<td>5795</td>
<td>2266</td>
<td>3529</td>
<td>39</td>
<td>61</td>
</tr>
<tr>
<td>2011</td>
<td>8115</td>
<td>3356</td>
<td>4759</td>
<td>41</td>
<td>59</td>
</tr>
</tbody>
</table>


Researches have attributed this failure to a number of factors. One of the isolated factors is teacher’s consistent use of teaching methods which do not lead to meaningful learning of science concepts and their application to solve problem. Despite the adoption of new approaches to teaching like child centered, problem–based or project-base method, inquiry method of teaching and others, the approach to teaching has predominantly remained unchanged as teachers persistently use traditional method to teach science (Abdullahi, (1997).

1.1 Objectives of the Study

The study has the following objectives:

1. To find out the impact of Context-Based Approach on chemistry students achievement.
2. To determine the impact of Context-Based Approach on the achievement of boys and girls.
3. To determine the impact of Context-Based Approach on the retention of chemistry concepts after exposure to Context Based Approach.
1.2 Research Questions

This study attempted to answer the following questions:

1. Is there any difference in academic achievement of students exposed to Context-Based Approach and those exposed to lecture method of teaching?
2. Is there any difference in academic achievement in chemistry between boys and girls when exposed to Context-based approach?
3. What is the impact of Context-based Approach on students retention level of chemistry concepts

1.3 Null Hypotheses:

The following hypotheses were developed for the study:

$H_0_1$: There is no significant difference in the academic achievement of students taught chemistry using Context-based Approach and those taught using lecture method of teaching

$H_0_2$: There is no significant difference in the academic achievement of boys and girls when exposed to Context-Based chemistry teaching.

$H_0_3$: There is no significant difference in the level of retention of chemistry concepts by students taught using Context-Based Approach and those taught using lecture method.

2. Methodology

The research design adopted for this study was pretest-posttest quasi experimental control group design. Two groups of students were used for data collection. One of the groups served as the experimental group (G1) and the other as the control group (G2). The two groups were pretested to determine their equivalence in ability. The experimental group was taught chemistry using context-based approach, while the lecture method was used to teach the control group. At the end of the treatment period; a posttest was administered to both groups in order to determine the effectiveness of the treatment on academic achievement in chemistry. The post-posttest was administered two weeks after the administration of the posttest to determine the level of retention of the chemistry concepts learnt. The same test was administered as pretest, posttest and post-posttest; the questions in the post-posttest were reshuffled to avoid remembrance.

The population of the study comprised all science secondary schools in Kano State. There are six government science secondary schools in Kano State. Stratified random sampling technique was used to identify the sample. Stratified sampling is a way to guarantee desired representation of relevant subgroups
within the population like gender. Four schools were selected two males and two females due to the nature of data needed to test the stated hypotheses as they require the need to compare male and female performance. The selected schools are: A, B, C & D

For data collection Chemistry Achievement Test (CAT) was used. CAT is an achievement test adapted from West African Examination Council past question papers. It contains 30 structured multiple choice items with one correct answer and three distractors for each set. The items in the test covered all the topics to be taught. CAT was used both as pretest, posttest and post-posttest. The instrument was given to a panel of experts, which comprised of two science educators a Professor and a Senior lecturer, two secondary school chemistry teachers and an expert in test and measurement to assess the content and face validity of the CAT. The data was analyzed using t-test.

3. Results and Discussion

Is there any difference in academic achievement of students exposed to Context-Based Approach and those exposed to lecture method of teaching?

To provide an answer to this research question, the mean scores of students exposed to context-based approach and those exposed to lecture method of teaching chemistry in Chemistry Achievement test was used. The analysis is as shown in table 2

Table 2 Post-test Means and Std. Deviation of Experimental and Control Groups Based on Achievement in CAT

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>Pretest Mean Scores</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>60</td>
<td>16.33</td>
<td>19.53</td>
<td>3.88</td>
</tr>
<tr>
<td>Control</td>
<td>60</td>
<td>16.38</td>
<td>16.68</td>
<td>4.35</td>
</tr>
</tbody>
</table>

From Table 2 the mean score of the experimental group exposed to context-based approach is higher than the mean score of the control group exposed to lecture method of teaching chemistry. Therefore there is difference in the achievement of the experimental group exposed to context-based approach and the control group exposed to lecture method of teaching chemistry. This means that context-based approach enhance students achievement in chemistry. To find out whether significant difference exist or not among
the mean score of the experimental group exposed to context-based approach and the control group exposed
to lecture method of teaching chemistry, t-test was used.

HO1: There is no significant difference in the academic achievement of students taught using
context-based approach and those taught using Lecture method.

To test this hypothesis, the post-test of the experimental and control groups were analyzed using the t-test
statistics. The result of the t-test analysis is shown in Table 3

Table 3 Result of t-test Analysis of CAT Post-test Means Score of the Experimental and Control
Groups Based on Achievement

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>t-cal</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp’tal</td>
<td>60</td>
<td>19.53</td>
<td>3.88</td>
<td>.50</td>
<td>-3.87</td>
<td>0.00*</td>
</tr>
<tr>
<td>Control</td>
<td>60</td>
<td>16.68</td>
<td>4.35</td>
<td>.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant

From Table 3 the p-value of 0.00 is less than the 0.05 level of significance set which is an
indication that there is significant difference between the control group and the experimental group in
Chemistry Achievement Test. This shows that the students in the experimental group achieved higher than
the students in the control group in Chemistry Achievement Test. The mean score of the experimental group
as shown in Table 3 is 19.53 which is higher than 16.68 mean score of the control group. This indicates that
the experimental group exposed to Context-Based Approach performs better than the control group exposed
to lecture method.

Based on the result of Table 3, the hypothesis which states that there is no significant difference in
the academic achievement of students taught using context-based approach and those taught using Lecture
method is rejected. There is significant difference in the achievement of students taught using Context-
Based Approach and those taught using Lecture method in favour of those taught using Context-Based
Approach. The Context-Based Approach was therefore more effective in improving student’s achievement
than the lecture method.

Is there any difference in academic achievement in chemistry between boys and girls when exposed to
Context-based approach?
The data collected for the purpose of answering this question was analysed using descriptive statistics in the form of mean and standard deviation. From Table 4, the mean score of the boys and girls are averagely the same with the boys with 11.23 and the girls with 11.46. This indicates that there is no difference in the academic achievement of boys and girls when exposed to context-based approach.

$H_{02}$: there is no significant difference in academic achievement of boys and girls when exposed to context-based chemistry teaching.

The result of the post-test score of the experimental group was used to test this hypothesis. The result is shown in Table 4

**Table 4 Result of the t-test Analysis of Post-test Means Score of CAT for the Experimental Group Based on Gender**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>t-cal</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>30</td>
<td>11.23</td>
<td>3.07</td>
<td>.56</td>
<td>1.56</td>
<td>.77*</td>
</tr>
<tr>
<td>Girls</td>
<td>30</td>
<td>11.46</td>
<td>3.36</td>
<td>.61</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*not significant

From Table 4, the calculated t-value of 1.56 is less than the critical value of 2.000 at the degree of freedom of 58 at 95% confidence level. The obtained p-Value of 0.77 at $P \geq 0.05$ was not significant. These results indicate that there is no significant difference in the achievement of boys and girls when taught chemistry using Context-Based Approach. This implies that boys and girls perform equally well when exposed to CBA. The null hypothesis is thus retained.

What is the impact of Context-based Approach on student’s retention level of chemistry concepts?

To answer this research question the students score in the post-posttest Chemistry Achievement test was used. The mean of the two groups that is the experimental group exposed to context-based approach and the control group exposed to lecture method of chemistry teaching was calculated as shown in Table 5
From Table 5 the mean of the experimental group exposed to context-based approach is 19.3 which is higher than the mean of the control group exposed to lecture method of chemistry teaching (11.7). This indicates that context-based approach improves retention of learned chemistry concept.

HO3: there is no significant difference in the retention of chemistry concepts by students taught using context-based approach and those taught using Lecture method.

The data used to test this hypothesis were the student’s post posttest means score of the experimental group exposed to Context-Based Approach and the control group exposed to Lecture method. The mean scores of the two groups were subjected to t-test statistical analysis. The result of the t-test analysis is shown in Table 6

From Table 6 the t-calculated 10.27 was found to be higher than the t-critical 1.97 at the degree of freedom of 118. This shows that there is significant difference in the retention between the control group and the experimental group. The mean score of the experimental group as shown in Table 6 is 19.30 which is higher than the mean score of the control group which is 11.75. This indicates that the experimental
group exposed to Context-Based Approach retained learned concept in chemistry better than the control group exposed to lecture method.

Based on the analysis of Table 6, the hypothesis which states that there is no significant difference in the retention of chemistry concepts by students taught using context-based approach and those taught using Lecture method is therefore rejected. There is significant difference in the retention of learned chemistry concepts of students taught using Context-Based Approach and those taught using Lecture method in favour of those taught using Context-Based Approach. The Context-Based Approach was therefore more effective in retention of learned chemistry concepts.

The result from the responses and testing of the hypothesis indicates that the experimental group who were taught using Context-Based Approach achieve significantly better than those in the control group who were taught same concepts using Lecture method. The significant difference in achievement is in favor of the students in the experimental group which suggest a greater effectiveness of Context-Based Approach over the Lecture method of instruction. This finding is in conformity with that of Gutwill-wise (2001), and Longe and Parchmann (2002) who reported that students exposed to context-based approach significantly outperformed students exposed to traditional method of teaching in cognitive test. The researches revealed a deeper and better understanding of science concepts in favour of students taught using context-based approach.

Students improved achievement might be that the instructional strategy provides opportunity for students to link concepts learned to real life situation. Context-Based Approach enable students to establish a relationship between concept learned and real world application thereby increasing achievement as indicated in the research and supported by the research conducted by (Hofstein et al., 2001) whose research showed that context-based approach helps students to see and appreciate more clearly links between the science they studied and their everyday lives. Barber, (2000); Ramsden, (1997) researches also showed that student taught using context-based approach see and appreciate more clearly links between science and everyday lives which in essence helps the students see the relevance of chemistry to their lives.

The result of the students in the control group showed that lecture method is not very effective in promoting meaningful learning and increasing achievement. As students in lecture method are engaged as passive learners. This is in line with the argument of Steinhorst and Keeler (1995), that traditional Lecture method has a tendency to view students as passive learners because it does not engage them actively. The finding from this study indicates that Context-Based Approach can enhance academic achievement among students and yield better result than Lecture method.
Results from the responses and testing of Hypothesis 2 showed that there is no significant difference in the achievement of boys and girls when exposed to Context-Based Approach. The t-test of the posttest scores revealed no significant difference in the achievement level of the boys and girls as shown in Table 4. This means that Context-Based approach is an instructional strategy that is gender friendly as it gives equality in learning for both sexes. This findings support the findings of Bennett et al., Robinson (2005) who reviewed researches in gender and Context-Based approach. Their review indicated a bridge in the gap of performance of boys and girls when taught using Context-Based approach. This shows that boys and girls benefited equally when exposed to Context-Based Approach. This could be argued to be as a result of how concept is presented to the students. Concepts are presented in such a way that it has direct bearings and relevance to the lives of the students which capture the student’s interest and thus all the students regardless of gender are motivated to learn. As the method is interactive, weak students learn from their colleagues and could overcome their learning difficulties.

Another finding of this research showed significant difference in the retention of learned chemistry concept between the experimental groups taught using Context-Based Approach and the control group taught using Lecture method. This finding showed that teaching using Context-Based Approach helps the students retain the learned concepts better as is shown in Table 6. There is significant difference in the achievement of the experimental group taught using Context-Based Approach and the control group taught using Lecture method in favor of the experimental group.

This finding confirmed Akinbobola and Folashade (2007) argument that when teaching is characterized by rote learning, meaningless memorizing on verbalism, students make ineffective learning, and the facts thus learned are not long retained, nor do they seem to have much effect in changing behaviour. Context-Based Approach helps students to see the relevance of concept learned to their everyday lives which makes retention to be effective as individuals see the meaning or purpose for that information and provide opportunity for students to establish a link for concepts learned. When learning is made more meaningful, concepts are better organized and retention is improved. This finding also supports the findings of Chianson et al., 2010) that conventional or traditional approach to teaching is not very effective in aiding retention. The finding confirmed that of Potter and Overton (2006) that context-based approach could help student retain concepts taught to them.
4. Conclusion

Based on the findings of this study, the following conclusions were drawn.

1. Context-Based Approach is more effective in increasing the achievement of Senior Secondary School Students in chemistry than the Lecture Method.

2. Students taught using Context-Based Approach retained more learned chemistry concepts than students taught using Lecture method.

3. Context-Based approach is gender friendly as both gender showed improved performance when taught chemistry concepts.

5. 1 Recommendations

1. Lecture method in this research study has been found to be less effective in ensuring learning and retention of learned concepts. Therefore science teachers should look for alternative and more effective means of instruction to avoid under performance of their students.

2. Context-Based Approach has been shown to improve Academic Achievement for both sexes; therefore teachers should be advised to adopt the approach in teaching.

3. Organizations like Science Teachers Association of Nigeria (STAN), National Educational Research and Development Centre and others should incorporate Context-Based Approach in Science curricula at Senior Secondary School level to encourage use of the strategy among science teachers.

4. There is a need for curriculum planners and textbook writers to take into cognizance Context-Based Approach in developing the curriculum and the textbooks as context for each unit of learning must be identified. This will simplify adoption of the method for use by teachers.
References


