Re-engineering the Teaching and Learning of Basic Science Through the Use of Adaptive Teaching Strategy

By

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Abstract

The study investigated the effect of adaptive teaching strategy on the achievement of students with individual differences and special needs in Basic science classroom in Owerri municipal L.G.A in Imo State. The researcher adopted 2:2 factorial design in which the experimental and control groups were given pre-test and post-test. The researcher formulated one research question and two hypotheses to guide the study. The instrument used for the study was the Basic Science Adaptive Teaching Achievement Test (BSATAT) which was structured by the researcher based on the two topics taught, classes of levers and simple machines. The instrument was validated and reliability ensured. Mean scores and Standard deviation were used to answer the research question while t-test was used to test the hypothesis at .05 level of significance. Data analysis revealed that the mean score achievement of students in experimental group is greater than those of control group. The t-test analysis revealed that there is significant difference between the mean score achievement of experimental group and control group in basic science achievement test. It also revealed that adaptive teaching is gender friendly. Based on these findings, recommendation were made, one of which is that basic science teachers should be sensitized on the use of adaptive teaching strategy through seminars, workshops and conferences.

It has been observed that student in different classrooms vary in Experiences, socio-economic status (SES), cultural and ethnicity, language and learning style, (Borich 2011, Santrock 2004). Explaining further on this observation, Borich in Educational lab (2011) stated that without teacher’s help, those learners especially those with reading disabilities could have limited academic success. As an effective teacher, the ethics of teaching profession requires that the teacher should try and actively contribute everything possible to help these learners irrespective of their differences and disabilities. For any teacher to offer this help, he needs to recognize student individual differences and special needs. When this is certain then he will be in a better position to help them use their own experiences and learning histories to derive meaning and understanding from what he is teaching. The teacher may use a specialist in child psychology to diagnose these students with special needs or problems. When this is done the teacher can re-engineer or re-position his instructional methods to the learning
needs of the students and employ different instructional methods with different learners. This process of accommodating learners with different instructional methods is referred to as adaptive teaching (Borich 2011). Adaptive teaching is a way of re-engineering the teacher’s instructional method and material to match with the learners’ reading disabilities. Santrock (2004) referred to this adaptive teaching as intervention strategies. He gave a list of such intervention strategies for children with learning disabilities as:

i. **Take the Needs of the Child with Learning Disability into Account During Instructional Time.** This can be done by stating objectives clearly in each lesson. Present it virtually on the board, or with an overhead projector as well making sure that directions are explicit, explain them orally. And also use concrete examples to illustrate abstract concept

ii. **Provide Accommodation for Teaching and Assignments.** This refers to changing the academic environment so that the learner can demonstrate what they know. Common accommodation includes reading instruction to children, highlighting important words (such as underline, or answer two of the three questions, untimed tests and extra time on assignments

iii. **Making Modifications:** This strategy changes the work itself making it different from other children’s work in an effort to encourage children’s confidence and success, asking a child with dyslexia to give an oral report while other children give written report is an example of modification.

Santrock (2004) noted that different instructional methods when matched to the individual strengths and needs of the learners can significantly improve their achievement. Cronbach and Snow (1981), Tomlinson and Mctighe (2006) also noted that achievement can be increased when the instructional method favours the learner’s modalities for learning. More studies by Cushnor, McClelland and Stafford (2008), DAmno and Gallaway (2008) stated that adaptive teaching strategy improves students’ achievement. Borich (2011) explained that adaptive teaching has many benefits some of which are; (i) Adaptive teaching works to achieve success with all students regardless of their individual differences. He stated that it can be achieved either by remediation (building the knowledge skills or abilities required to profit from the planned instruction or by compensation) emphasizing instructional methods/materials that rely on learner abilities that may be more highly developed. Borich (2011:42) gave a list of the most promising instructional alternatives in adaptive teaching as:

- Co-operative grouping versus whole class instruction.
- Inquiry versus expeditionary presentation.
- Rule-example versus example-rule ordering.
- Teacher centered versus student centered presentation.
- Direct versus indirect instruction
- Example from experience versus example from text.
- Individual responses versus choral responses.
- Computer-driven text versus teacher presentation, etc.

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**Academic Excellence**
These studies by different researchers enumerated above were not carried out in Nigeria and not in Basic science also. It is in this regard that the researcher is poised to investigate the effect of adaptive teaching strategy on the achievement of students with reading disabilities in Basic science in Owerri Educational Zone. The adaptive teaching approach to be used is compensatory approach whereby some instructional approach will be selected to compensate for the lack of information, skills or ability known to exist among learners by altering the content presentation to circumvent a weakness and promote strength.

**Statement of the Problem**

Studies have revealed that students in the same classroom vary in experiences, socio-economic status, prior achievement, learning abilities, learning styles, etc. (Borich 2011). Borich noted that among these students with individual differences, some of them have learning disabilities and if not helped by the teacher, may have limited academics success. This is because the conventional teaching method does not take care of these individual differences. Based on this, researchers have noted that adaptive teaching can be used to enhance the learning ability and achievement of these students (Tomlinson and Mc Tighe 2006). Cronbach and Snow (1981). Since these works were not carried out here in Nigeria especially not in Basic science, the problem can therefore be stated thus: can adaptive teaching enhance achievement of students with individual differences in a classroom? Can adaptive teaching be used to enhance teaching and learning in Basic science among students with difficulties in reading. The researcher is poised to investigate the effect of adaptive teaching among students with reading disabilities or learning needs in Basic science classroom.

**Conceptual Frame Work**

Adaptive teaching is one approach to achieving a common instructional goal with learners who have individual differences such as prior achievement aptitude, learning style, etc. Adaptive teaching techniques, according to Borich (2011), apply different instructional strategies to different groups of learning so that the natural diversity prevailing in the classroom does not prevent any teacher from achieving success. Torno and Snow (1986) noted that there are two approaches to adaptive teaching: The remediation approach and the Compensory approach.

**Purpose of the Study**

The general purpose of this study is to determine the effect of adaptive teaching on student’s achievement in Basic science. Specifically the study seeks to ascertain if adaptive teaching can be used to improve students’ learning ability.

**Research Question:**

The researcher formulated one research question to guide the study. What is the effect of adaptive teaching on student’s achievement in Basic science?
Research Hypothesis I

The researcher formulated one hypothesis to guide the study and it was tested at 0.5 level of significance

1. There is no significant difference between the mean achievement of students who were exposed to adaptive teaching and those who were denied the adaptive teaching.

2 Hypothesis II
There is no significant difference between the mean achievements of the male and female students with reading disability who were taught basic science with adaptive teaching strategy.

Research Procedure and Design

The study is a quasi-experimental study treatment and post-test were given to experimental groups to determine the effect of adaptive teaching approach on students’ achievement in Basic science and also to determine if there is any significant difference between the mean achievement of male and female students exposed to adaptive teaching approach. The study was carried out in Owerri Municipal L.G.A Owerri Educational Zone of Imo- State.

Population for the Study

The population for the study consisted of 488 students in all the government owned Junior secondary schools in Owerri Municipal Council L.G.A of Imo State.

Sample and Sampling Technique

The researcher used purposive sampling technique to select two junior secondary schools: one boys’ and one girls’ secondary school. Each school has about five arms of JSS3 and from each of these schools, a simple random sampling technique was used to select one arm of the students (one class). The number obtained were 50 and 54 respectively, which gave a total sample of 104. The intact class was not distorted, rather each class was randomly assigned to groups (Thus: group A and B)

The Instrument Used for the Study

The instrument used for study was the Basic science adaptive teaching achievement test (BSATAT) which consisted of 35 multiple choice and completion type test items based on the topics dealt with in the teaching Session (simple machines and classes of levers). The first 15 questions were used for pre-test while the remaining 20 item questions were used for post-test.

Validation of the Instrument

The instrument was given to experts in measurement and evaluation for criticism. Based on their criticisms some of the items were expunged and replaced with better options and thus validity was ensured.
Reliability of the Instrument

The instrument (BSATAT) was administered twice in a pilot test to a group of students who were not listed for the study. The first test was administered and after two weeks interval another test was administered using the same instrument. The two sets of scores obtained were co-related using Person Product Moment Correlation formula and a correlation co-efficient of .81 was obtained which indicated that the instrument was reliable enough to collect data for the study.

Method of Data Analysis

The research questions were answered using mean scores and standard deviations and any mean score which is upto and above 2.50 which is the average mean for a four point Likert scale was regarded as positive response while mean scores which are below 2.50 were regarded as positive response while mean scores which are below 2.50 were regarded as negative mean scores.

The t-test statistical method was used to test the hypothesis at .05 level of significance. The result of the findings was regarded significant if t-table is greater than the calculated t and non significance if the calculated t is greater than the critical (table-t).

The Procedure for the Study

The dependent variable was the method of instruction (adaptive teaching strategy) with two groups of learners (A and B) while the independent variable was the post-test scores and pre-test scores.

The first part of the instrument (BSATAT) which comprised of 20 item questions was used for pre-test for the two groups. The purpose being to assess students’ prior knowledge on the topics selected for the study. The second part of the instrument which consisted of 20 item questions was used for post-test. The post-test was administered to measure treatment effect (adaptive teaching effect—lessons with experienced oriented activities and pictures). Both groups were given post—test at the end of the teaching session.

The Teaching Session

The researcher taught the experimental group (group 1) the two topics-classes of lever and simple machines in two consecutive days. The control group was not taught the same way but the same days using two lesson periods of 80 minutes for one lesson. The experimental group was presented lesson in a more experiential way, activity—oriented lesson support with pictures of simple machines and classes of levers. Students were allowed to interact with the relevant instructional materials while the control group was taught using only lecture method and examples on these material which they never saw nor interacted with. On the third day, both group had post-test. Two research assistants supervised the test as it was taken simultaneously in their different groups. Students in both groups were scored objectively as every item carries equal mark.
Academic Excellence

Presentation and Interpretation of Results

The results of the findings were presented in tabular form according to the research questions and hypotheses that guided the study.

Table 1: Mean Scores Achievement of Experimental and Control Group on the Pre-test.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Test</th>
<th>N</th>
<th>( \overline{X} )</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>Pre-test</td>
<td>54</td>
<td>40.1</td>
<td>2.79</td>
</tr>
<tr>
<td>Control group</td>
<td>Pretest</td>
<td>50</td>
<td>39.72</td>
<td>2.91</td>
</tr>
</tbody>
</table>

Data in table I shows the mean score achievement and standard derivations of the experimental and control group on the pre-test. The mean score of both group indicates that they are equivalent group.

Research Question 1

What is the difference between mean achievement of students who were exposed to adaptive teaching and those denied the adaptive teaching (Experimental and Control groups respectively).

Table 2
Mean Scores of Experimental and Control Groups in Adaptive Teaching (Post Test).

<table>
<thead>
<tr>
<th>Groups</th>
<th>Method of Teaching</th>
<th>N</th>
<th>( \overline{X} )</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental group</td>
<td>Adaptive teaching</td>
<td>54</td>
<td>63.94</td>
<td>2.44</td>
</tr>
<tr>
<td>Control group</td>
<td>Lecture method</td>
<td>50</td>
<td>54.70</td>
<td>2.37</td>
</tr>
</tbody>
</table>

Data in table 2 shows that the mean achievement of students in experimental group is greater than those in control group (63.94>54.7). This implies that the treatment adaptive teaching strategy enhanced the students achievement in Basic science. The difference in mean score between the two groups is 9.24
Bar Chart Showing the Mean Score and Standard Deviation of the Control and Experimental Groups in the Post-test

Hypothesis I

There is no significant difference between the mean achievement of students who were exposed to adaptive teaching and those who did not receive the treatment.

Table 3: t-test Analysis of Non-significant Difference between the Mean Achievements of Experimental and Control Group.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Df</th>
<th>t-cal</th>
<th>t-tab</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>54</td>
<td>63.94</td>
<td>2.44</td>
<td>102</td>
<td>19.6</td>
<td>1.980</td>
<td>NHA</td>
</tr>
<tr>
<td>Control</td>
<td>50</td>
<td>54.70</td>
<td>2.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data analysis on table 2 revealed that the calculated t-value (19.6) is greater than the table t-value (1.98) at .05 level of significance. Therefore the null hypothesis stating a non significant difference between the achievement of experimental and control group was not rejected. The pre-test scores served as co-variates.

Hypothesis 2

There is no significant difference between mean achievements of the male and female students with reading disability who were taught basic science with adaptive teaching strategy.

Table 4: t-test Analysis of No Significant Difference between the Mean Achievement of Male and Female with Reading Problems Exposed to Adaptive Teaching Strategy.

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>Df</th>
<th>t-cal</th>
<th>t-tab</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>27</td>
<td>64.33</td>
<td>2.12</td>
<td>102</td>
<td>0.47</td>
<td>±1.96</td>
<td>NHA</td>
</tr>
<tr>
<td>Female</td>
<td>27</td>
<td>64.17</td>
<td>2.21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Result of data analysis shown in table 3 revealed that the value of \( \text{calculated } t \) = -0.47 is less than the value of “critical \( t \)” or \( \text{table } t \) = ±1.96. This implies that there is no significant difference between the mean achievement of male and female students with reading problems, exposed to adaptive teaching strategy. Therefore the null hypothesis which states that there is no significant difference between mean achievement of male and female was not rejected.

**Discussion of Results**

The result of the analysis in table 1 revealed that there is a difference in the mean achievement of dystexia students who were taught Basic science with adaptive teaching strategy and those who were taught with lecture method. See table 2, (63.94>54.70). Data in table 3 revealed that there is a significant difference between the mean achievement of experimental group and control group. (see table 3, \( t_{-\text{cal}} 19.6>1.980 \)) at 0.05 level of significance. The significance difference shown by t-test analysis was an evidence that adaptive teaching strategy enhanced the achievement of students in Basic science. Therefore adaptive teaching strategy is an effective approach for enhancing the ability and achievement among students with individual differences in Basic science classroom. This finding is in line with the work of Tomlinson and Mctighe (2006). They stated that when a good instructional method is matched with the needs of the learners, their achievement can be improved. The finding is also in line with the work of Borich (2011). He noted that students with individual differences or even learning disabilities when helped by the teacher using adaptive teaching strategy, improved on their learning ability and academic achievement. With regards to hypothesis two result of data analysis revealed that there is no significant difference between the mean achievement of male and female students with reading problems expose to adaptive teaching strategy. (\( t_{-\text{cal}} 0.47 < t_{\text{crit+}} 1.96 \) or \( t_{\text{crit+}} 1.96 > t_{-\text{cal}} = 0.47 \)). This implies that adaptive teaching strategy is gender friendly. This is in line with the assertion of Borich (2011). He stated that adaptive teaching makes a lot of difference in the achievement of all students regards less of their individual differences or problems. Based on the findings, the following recommendations were made;

**Conclusion**

The study investigated the effect of adaptive teaching strategy on the achievement of students with individual differences and special needs. The study was carried out in Owerri with students in Junior Secondary School Owerri in Educational zone. The researcher adopted 2:2 factorial design in which the experimental and control group were given pre-test and post-test. The study was guided by one research question and two hypotheses. A researcher structured instrument was used, its validity and reliability were ensured. Mean score was used to answer the research question while test was used to analyze the hypothesis. The findings of the study revealed that adaptive teaching is an effective approach for enhancing the ability and achievement among students with individual differences and special needs. Adaptive teaching is gender friendly. Based on the findings recommending were made accordingly.
Re-Engineering the Teaching and...

Recommendations

(1) Based on the findings, the researcher made the following recommendations and be encouraged to adopt this method in their class to assist students with reading problems and other learning needs.

(2) Adaptive teaching strategy is a gender friendly strategy and therefore should be used in teaching both male and female students with individual learning needs.

(3) The government and school authorities should enhance the school environment by providing the basic infrastructures and facilities required for adaptive teaching method.

References


