Enhancing Senior Secondary Students’ Achievement in Algebra Using Inquiry Method of Teaching in Onitsha Educational Zone of Anambra State, Nigeria

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Abstract

This study investigated the effectiveness of inquiry teaching method on senior secondary one students’ achievement in algebra. One intact class each from four schools was selected out of 32 secondary schools in Onitsha Education Zone of Anambra State. These schools were stratified according to gender. One male and one female school were selected by balloting for each group. The sample for the study comprised of 123 senior secondary one students. The design used was quasi-experimental. The instrument used for data collection was Algebraic Mathematics Achievement Test (AMAT). The instrument was administered as pre-test and post-test before and after the experiment which lasted for 7 weeks to both experimental and control groups. The internal consistency of the instrument was computed to be 0.83 using K-R21. Two research questions and two hypotheses were set out for the study. Mean and standard deviations were used to answer the research questions while analysis of variance (ANOVA) was used to test the null hypotheses. Result of the study showed that students in the experimental group taught algebra using inquiry method performed significantly higher than students in the control group taught the same content using expository method. Also, male students in the experimental group were found to benefit more from inquiry method than their female counterparts. The significance of conducting this study is that it has provided mathematics teachers with an innovative and alternative teaching method of presenting algebra for easier understanding by the students-a method which is science and problem solving based. The study recommended that mathematics teachers should adopt inquiry teaching method in teaching mathematics in senior secondary schools.

Keywords: inquiry, inquiry method of teaching, exploratory method, Algebraic achievement test, teaching methods, experimental group and control group

INTRODUCTION

Mathematics is an essential tool for advancement of science and technology in this century. No nation can develop scientifically and technologically if it neglects mathematics. The formal education of any country especially Nigeria is primarily responsible for providing scientific and mathematics attitudes, fundamental skills, and ways of thinking as well as developing value in science particularly mathematics. These have made the twenty first century to witness an explosion of knowledge with so much new knowledge being discovered in every discipline of life, mathematics inclusive (Kurumeh, 2010).

According to Abakporo (2005) mathematics is the queen and substances of science and technology. Fafunwa (1990) and Fatunla (1992) all agreed to this fact that a nation can never become prosperous and economically independent without mathematics. For this reason the importance of mathematics competence of all learners at all levels of education particularly senior secondary school cannot be over emphasized. It is however disheartening that, going by the various Chief Examiners’ Reports in West African School Certificates examinations and public out cries the achievement in mathematics is nothing to write home about. Abakporo (2005) again laments that if mathematics is really the “queen of science’ and an essential tool for scientific and technological development, then common sense indicates that if nothing positive is done, the state of art of development in science and technology in Nigeria will be a mirage. Odili (2006) retorted similarly that, although more attention seems to be given to the course of teaching and learning of this important subject, yet no teacher saddled with the responsibility of teaching mathematics can say all is well with the teaching and learning of mathematics. (Sidhu 2006). Reports from different researches have also portrayed a poor state of Nigerian Students in terms of mathematics achievement. Odili (2006), Maduaburn and Odili (2006) and Ashikhhia (2010) in separate studies revealed low academic achievement in mathematics. This pattern of students performing
poorly in mathematics has brought much growing concern among parents, teachers, society, and within government circles. The fear is, if nothing positive is done, our scientific and technological development will be dwindle thereby affecting the hope and vision of Nigeria as one of the first 20 countries in scientific and technological advancement in 2020.

However, for a way forward to be sort for, causes of how our educational system has led us towards this path of failure must be reviewed. Harbor-Peters (2002) attributed poor teaching approaches and strategies used in the classrooms by teachers as one of the root causes of the undesirable poor achievement in mathematics. Available records have shown that researchers have discovered series of teaching approaches like Team Teaching (Achor, Imoko and Jimin, 2011), Ethnomathematics (Kurumeh, 2006), and discovery Method (Ajewole, 1997) which are capable of alleviating poor achievement of students in mathematics. Yet mathematics teachers are failing to use these approaches either due to logistics or due to financial implications for the provision of essential materials needed for teaching.

The researchers want to investigate the relative effect of inquiry method on the achievement of students in senior secondary school algebra. Awodi (1984) defines inquiry method of teaching as a process which encourages students to solve problems in a logical and systematic manner using the processes of science. These processes of science are characterized by various skills such as observing, comparing, hypothesizing, experimenting, data collections and interpretation of data. In inquiry method, the students are required to develop both the principle and the solutions of a problem (Lane, 2007). The inquiry method is a development of the discovery approach which is done with a view of finding some answers to reasons when certain problems exist. Inquiry investigations therefore go further and deeper than discovery and so the learner needs to use all his discovery abilities in order to succeed in true inquiry (Kurumeh, 2010). Inquiry method is therefore a true problem solving method and could be traced back to the work of Dewey (1933) who maintained that the learner should develop the intellectual fact and sensitivity to solve problems by inquiring constantly. As a result, true mathematics inquiry involves the unraveling of the hidden relationships about mathematical concepts (Asikhia, 2010).

Though, the advantages of inquiry method are numerous, the method is time consuming. The activities could be expensive in terms of funds since the approach requires a wide variety of materials and equipments. It is therefore not possible sometimes to use inquiry in all situations particularly in large classes. Also, students could be frustrated if they cannot solve the problems by themselves. The method could result to less coverage of scheme of work if not properly handled.

On the other side, inquiry method is a structured method of teaching mathematics which results in students gaining knowledge of the subject principles and concepts. It also results in students having the ability to formulate and resolve problems as well as communicate and acquire other skills necessary for working with people. The method also embeds in the students, positive curiosity which is essential for participating in a mathematics classroom. Students also develop social skills, problem solving abilities and attitudes necessary for self-directions. The method reduces the role of the teacher from dissimulator of information (Bess, 2000) to a guide in the process of teaching (Joe, 2007). With the above review in mind the researchers sought answers to such pertinent questions as, to what extent will inquiry method of teaching affect the academic achievement of senior secondary one students taught algebra? Also, to what extent will this achievement be affected by gender? This study is important to scholars and readers since it strengthens the relationship between mathematics and other sciences, the importance of mathematics to science, technology and national development, economy and justifies the position of mathematics as core and compulsory subject in all levels of education and in everyday living. Moreover, this study supplies scholars and readers with good, vital, viable, valuable and necessary information and knowledge for empirical materials for further studies or research.

STATEMENT OF PROBLEM
The information available from school records like WAEC (2006-2011), and research of Achor, Imoko and Jimin (2011), clearly showed that vast majority of students perform poorly in mathematics annually especially in algebra. Academic achievement in education is believed to be a product of teachers’ teaching method. It has been established and reaffirmed by investigation that creative teaching strategy that is learner-oriented and problem solving based as used in science and recommended by the chief examiners of WAEC (2010) should be used as a solution to this problem. Would the use of inquiry approach in teaching then be effective in the teaching of algebra and hence improve students’ achievement? To what extent then will inquiry approach affect the mean performance of male and female students in mathematics especially in algebra?

METHOD AND MATERIAL
The study investigated the relative effect of inquiry method of teaching mathematics on students’ achievement in algebra in Onitsha Education Zone of Anambra state, Nigeria. The purpose of the study was
to determine whether students exposed to inquiry method of teaching differ significantly in their general performance in algebra when compared to those in the expository method. Also the study sought to determine if there was any difference in achievement of male and female students taught algebra using inquiry method. The design of this study was quasi-experimental. The research design was adopted as a result of the researchers’ inability to completely randomize subject in experimental and control groups. The subjects’ intact classes were therefore, randomly assigned to experimental and control group. The area of study was Onitsha Urban Area of Onitsha Education Zone of Anambra State, Nigeria. The population comprised all the senior secondary one (SS 1) students located within the study area.

Sample size for the study was 123 SS 1 students randomly selected by balloting from four (4) out of 32 secondary schools in Onitsha Education Zone of Anambra State, Nigeria. The schools were stratified into two groups of two male and two female secondary schools. Two schools (one male and one female) were assigned to the treatment group while the others were assigned to the control group by balloting. The treatment group was taught algebra using inquiry teaching method while the control group was taught algebra using expository method. Research assistants were trained by the researchers for 4 hours to handle both groups. The instrument used for collecting data was Algebraic Mathematics Achievement Test (AMAT). The instrument was a 20 item test developed by the researchers and faced validated by 3 experts from mathematics education and measurement and evaluation. They were instructed to check for language, plausibility and sense of the items. Out of the 25 items, 20 items survived the exercise.

Research Questions

The following research questions guided the study:

1. To what extent do the mean achievement scores of students taught algebra using inquiry method differ from those taught using expository method?
2. To what extent will the mean achievement scores of male and female students taught algebra using inquiry method differ?

Research Hypotheses

The following hypotheses were formulated and tested at a 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of students taught algebra using inquiry method and those taught using expository methods.
2. There is no significant difference in the mean achievement scores of male and female students taught algebra using inquiry method.

DATA PRESENTATION, ANALYSIS AND RESULTS

Research Question 1

To what extent do the mean achievement scores of student taught algebra using inquiry method differ from those taught using expository method?

Table 1: Mean and Standard Deviation of Students in Experimental and control Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-Amat</th>
<th>Mean gain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( \bar{x} )</td>
<td>( \delta )</td>
</tr>
<tr>
<td>Experimental</td>
<td>63</td>
<td>24.67</td>
<td>12.61</td>
</tr>
<tr>
<td>Control</td>
<td>60</td>
<td>22.42</td>
<td>11.22</td>
</tr>
<tr>
<td>Mean difference</td>
<td></td>
<td>02.25</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 reveals mean and standard deviations of students from both experimental and control groups. Pre-test reveals that the experimental group scored an average mean of 24.67 and a standard deviation of 12.61. The table also reveals pre-test score for control group as 22.42 with a standard deviation of 11.22. The mean difference between the experimental and control group was 2.25 which was small and suggests similar ability between the two groups at pre-test.

Table 1 further reveals a post-test mean score for experimental group as 68.17 with a standard deviation of 13.08 while the control group had a mean average score of 50.25 with a standard deviation of 19.56. The mean difference between the two groups at post-test was 17.92 which appear to be large and suggest difference in students’ ability at post-test in favor of the experimental group.

The table also reveals the mean gain between pre-test and post-test of experimental group as 43.50. The mean gain between the pre-test and post—test for control group was 27.83 which was considerably lower than the experimental group. This further suggested that the experimental group performed better than the control group at post-test.

Research Question 2:

To what extent will the mean achievement scores of male and female students taught algebra using inquiry method of teaching differ?
Table 2: Mean and Standard Deviation of Male and Female Student in Inquiry Method

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>pre-Test</th>
<th>Post-Test</th>
<th>Mean Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>37</td>
<td>23.16</td>
<td>71.83</td>
<td>48.67</td>
</tr>
<tr>
<td>Female</td>
<td>26</td>
<td>26.18</td>
<td>64.50</td>
<td>38.32</td>
</tr>
<tr>
<td>Mean Difference</td>
<td>3.02</td>
<td>7.33</td>
<td>10.35</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 reveals the mean and standard deviations of male and female students in the experimental group. The table revealed that male students had a pre-test mean score of 23.16 with a standard deviation of 11.39 while female student had a mean score of 26.18 and a standard deviation of 13.83. The mean difference between male and female students was 3.02 in favour of female students.

Table 3: Analysis of variance (ANOVA) for students’ achievement scores by Teaching methods

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F cal</th>
<th>F critical</th>
<th>DECISION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between group</td>
<td>9630.208</td>
<td>1</td>
<td>9630.208</td>
<td>34.784</td>
<td>3.82</td>
<td>Significant</td>
</tr>
<tr>
<td>within group</td>
<td>3266.583</td>
<td>121</td>
<td>276.861</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>42299.792</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3 presents analysis of variance for students’ achievement scores. Table 3 indicates that the teaching methods have the F-value of 34.784 at 1 and 121 degree of freedom. Since the F calculated is greater than the F-critical (Fcal > Fcrit), we reject the null hypothesis of no significant difference in achievement of those taught algebra using inquiry method and those taught using expository approach.

Table 4: Analysis of Variance (ANOVA) by Gender and Inquiry Method

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>F cal</th>
<th>F crit</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Group</td>
<td>806.667</td>
<td>1</td>
<td>5.036</td>
<td>4.000</td>
<td>Significant</td>
</tr>
<tr>
<td>Within group</td>
<td>9291.66.7</td>
<td>61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>10098.333</td>
<td>62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4 presents analysis of variance for gender and inquiry method. The table shows that F calculated is 5.036 at 1 and 61 degree of freedom. Since the calculated F value was greater than the critical value 4.000 at 0.05 level of significance, the null hypothesis of no significant difference in academic performance is not accepted. These meant that inquiry method had effect on gender.

DISCUSSION OF FINDINGS

On the bases of the results presented, the following are the findings made;

1. There is significant difference in the mean achievement scores of students taught algebra using inquiry teaching method and those taught using expository method. This finding is in agreement with the observations made by Gbamanga (1991), Ajewole (1991) and AAAS (1990) that inquiry method of teaching is efficient and applicable for teaching sciences and mathematics. The effectiveness of inquiry method is attributed to its child-centeredness that provides the learner opportunity to be actively involved in the learning process.

2. There is significant difference in the performance of male and female students taught algebra using inquiry method in favor of male students. This finding is in agreement with James and Awodi (1997) who asserted that there is a significant difference between male and female student performance in inquiry method. This finding also agrees with the finding of Bajah (1979) who asserted that gender has strong differential effect on students’ academic achievement in science and mathematics. The reason for this finding...
could be as a result of male students showing more interest during the lesson, paying more attention and participating in the inquiry activities. The fact that boys are more ready to explore situations while girls are naïve and remains adamant could have contributed to the difference in their performance.

LIMITATION OF THE STUDY
The researchers met with some problems that could have affected the results of this study. Since the test was used as pretest and post test, it might have developed an Hawthorn effect. This must have affected part of the students’ performance in post test achievement. Moreover the sample size 123 students used for this study may limit the generalizability of the findings.

RECOMMENDATIONS
Based on the finding of this research, the following recommendations were made:

1. Since it has been observed that those taught algebra using inquiry teaching method performed better than their control group counterparts, it is recommended that teachers of mathematics should adopt inquiry method in their teaching for better achievement.

2. It has been shown that inquiry method is activity and child-centered oriented, teachers of mathematics should adopt the method to dissipate boredom from their classrooms. The students would be kept very busy since they enjoy activities.

3. The research findings indicated that male students performed better than female students when taught using inquiry method. Mathematics teachers should therefore pay more attention to female students during the process of teaching to ascertain female students are equally participating in class activities to bridge the gap created in academic performance of male and female students as observed in the study.

REFERENCES


