Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.5, No.14, 2014

Effect of Guided Scoring Approach to Science Instruction on Senior Secondary School Students Achievement in Algebra

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Abstract
The study investigated the effect of guided scoring instructional approach on senior secondary school students' achievement in algebra. The study employed a non-equivalent control group quasi-experimental design. The study was conducted in two secondary schools. In one of the schools, intact class of SSII was assigned to the treatment group while in the second school the intact classes of SSII were assigned to the control group. The treatment group was taught algebra using guided scoring instructional package while the control group was taught algebra using the conventional teaching package. Three research questions and three null hypotheses guided the study. Algebra Achievement Test (AAT) was used to collect data for the study. The data were analyzed using mean, standard deviation and analysis of covariance (ANCOVA). The result revealed that guided scoring instructional strategy is superior to the conventional teaching strategy in facilitating achievement in algebra. The study also revealed that although with guided scoring instructional approach male students showed higher achievement than the female students, the difference in the mean achievement of males and female students taught using the guided scoring strategy is not statistically significant.
Keywords: Algebra, Guided scoring strategy, Achievement, Treatment interactions, Arithmetic

1.1. Introduction

Mathematics is the life wire of all scientific and technological activities of man. Ugama (2009) stated that mathematic is the only language and culture that is common to all studies. The branches include arithmetic, algebra, geometry, calculus, statistics topology, mathematical modeling etc. Algebra is the branch of mathematics concerned with the study of the rules of operations and things, which can be constructed from them, including terms, polynomials, equations and algebraic structures (Wikipedia, the free encyclopedia, 2010). Algebra is one of the main branches of pure mathematics and includes basic/elementary algebra, abstract algebra, linear algebra, universal algebra, algebraic number theory, algebraic geometry and algebraic combinatory (Boyer, 1991). Elementary algebra predominates the curriculum in secondary education and introduces the concept of variables representing numbers.

The role of algebra in development of science, technology and even art and humanity is highly indispensable. Its skills, knowledge and correct application help both individuals and nations to solve everyday problems. It develops confidence in using variables and functions to model numerical patterns and quantitative relations. To demonstrate knowledge of algebra, students should be able to use variables to represent and analyze problems numerically and perform calculations accurately. Linear inequality model are usually used in management model decisions and can be effectively applied by business managers to improve their managerial effectiveness (Mark, 2008). Operation research (OR) uses linear programming models to boost effective purchasing, production and sales decision. Minimization of the cost and profit maximization in firms as well as transport distribution network is possible as a result of application of useful algebraic concept.

Despite the roles played by algebra in the development of science and the current efforts in mathematics instruction, there is still persistent poor achievement of student in that area. WAEC Chief Examiners Report of 2006, 2007, 2008, 2010 and 2011 stated that the modal mark for most centers in mathematics was either zero or near zero. Chief Examiner's Reports showed that the poor achievement of students in mathematics is traceable to their poor understanding of the algebra content (WAEC 2008, 2010). WAEC (2007, 2010) categorically noted that students lack basic skills in algebra and as well commit errors in solving algebraic problems. WAEC Chief Examiners Report of 2007 revealed that students were weak in simplification of equations and interpretation of quadratic graphs. This has a direct bearing on the fact that they have poor knowledge in simplifying algebraic expressions. Emmos (2004) stated that Junior Secondary School students find it difficult to comprehend the concept of inequality. This implies that the students attend senior secondary school level with poor pre-requisite knowledge and background of the concepts. This according to Abonyi and Ugama (2005) makes it extremely difficult for the students to attain higher mastery as they progress in studies in mathematics and subsequently contributes to the poor achievement of students in science and technology based courses at the tertiary level. John (2006) observed poor achievement of Secondary School students in inequality and concluded that there is need to plan strategies that will improve students understanding of the concept especially at the lower level

Many approaches have been used in the past for teaching algebra. These include problem solving, discovery methods, concept development and advanced organizers. In spite of the application of these instructional

techniques senior secondary school students' achievement in algebra is still low.

Over the years there has been a growing emphasis on the need for a total integration of the learners into the instructional and evaluation processes. While learners participate in the instructional processes they are usually neglected in the evaluation exercises thereby depriving them the opportunity of appreciating the errors they commit as they solve algebraic problems. Error minimization in mathematics requires that students participate in identification of their own errors (Onugwu, 1991). This tends to suggest that an instructional strategy that integrates error identification may provide the requisite panacea for endemic poor performance in algebra at the secondary school level.

The guided scoring approach to instruction, by its nature, is an approach that completely integrates the learners into the assessment exercise and thus offers them the rare opportunity of witnessing their errors and sources of failures in execution of tasks. Guided scoring strategy is used as an assessment and instructional tool and thus creates room for the students to be integrated in scoring test/examination in the classroom. It is child centered (Kwok, 2008). Airagin, (1997) stated that guided scoring instructional strategy allows students to enjoy the service of ownership and direct involvement in judging the quality of instruction. This approach exposes the learners what is involved in scoring and the procedures that are requisite in solving a given problems. It promotes critical thinking, enhances learning and critical understanding of evaluation criteria and the knowledge gap. It further develops in learners social and communication skill and imbibes in them useful transferable skills like giving and handling criticism, self justification and assertion (Topping, 2008).

Working with and evaluating students among themselves in co-operative learning often result in greater motivation and higher sense of self esteem among students and increased willingness to accept tasks and improved interpersonal relationship (Elliot and Higgens, 2005). Guided scoring method in algebra gives students impetus to explicitly or implicitly hold themselves mutually responsible for the successful completion of the instructional exercise (Topping, 2003). Students are offered the rare opportunity to assess their neighbour's work in line with the marking guide provided by the teacher (Orogwu 2006). In the marking guide the scores are allotted step by step depending on the nature of the question. The marking scheme reveals the procedure that is required to reach the desired conclusion. It also shows the importance of the processes of arriving at an answer. Marks allotted to a given question follow a procedural pattern adopted by WAEC, NECO, NABTEB and other well registered examination bodies. The marks adopted include: Method Marks (M), Accuracy marks (A) and Accuracy dependent on method marks (MA).

The more students are guided in test scoring, the more they generate interest and perseverance to learn (Inoue, 2005). Students are excited to discover their mistakes and adjust as appropriate (Orogwu, 2006). When students partake in test scoring they will see the processes that are involved in marking thereby identifying their mistakes along the scoring lines in problem solving (Oragwam, 2006).

Although teachers realize the importance of processes in solving problems, they do not seem to show the students the important steps that need to be shown in their working procedures. Sometimes, teachers do not even bother to draw up marking schemes, and if they do, it is only known to them. All that the students realize is that they did not score as much as they actually expected for reasons best known to the teacher. At worst, students compare answers and end up attaching emotional reasons to their low scores. At times, teachers are given large class to teach which makes it impossible for them to revise the test items with students and to reveal their mistakes to them.

Although guided scoring has been used strictly as an assessment tools its inherent gains as an instructional strategy raises obvious hope for researchers in pedagogy. While it is speculated that integration of guided scoring in instructional process will have interesting implications, researcher should not loose sight of the fact that scoring exercises and the accompanying interaction process may involve gender issues that cannot be dismissed with a wave of hand. In fact, the extent to which the infusion of guided scoring into regular classroom instruction could influence the achievement of senior secondary school students in algebra both collectively and differentially demands very urgent research attention.

1.2. Objectives of the Study

The main objective of this study is to determine the effect of guided scoring instructional strategy on senior secondary school students' achievement in algebra. Specifically, the study explored:

(1). the effect of guided scoring instructional strategy on students achievement in algebra

(2). the differential effects of guided scoring instructional strategy on the mean achievement of male and female students in algebra.

(3). the interaction effect of gender and method on students' achievement in algebra.

1.3. Scope of the Study

The study focused on the effect of the integration of guided scoring strategy in regular classroom instruction on Senior Secondary School Students' achievement in algebra. The following topics in algebra were covered in this study: linear inequalities, linear expression, linear equation, quadratic equation, variations, simplifications, coefficient of terms, simultaneous equation and change of subject formulae. The study was restricted to senior

secondary class II only.

1.4. Research Questions

The following research questions guided the study:

1. What is the effect of the guided scoring instructional strategy on the mean achievement scores of student in algebra?
2. What is the effect of the guided scoring instructional strategy on the mean achievement scores of male and female students in algebra?
3. What is the interaction effect of gender and methods on students' mean achievement scores in algebra?

1.5. Hypotheses

The following null hypotheses guided the study and were tested at an alpha level of 0.05.

HO_1: There is no significant difference in the mean achievement scores of student taught algebra using guided scoring instructional strategy and those taught using conventional method

HO_2: There is no significant difference in the mean achievement scores of male and female students who were taught algebra using guided scoring instructional strategy.

HO_3: The interaction effect of gender and method on students' mean achievement in algebra is not significant.

2.1. Method

This study used quasi-experimental design. The specific design the researchers used for the study is a pretest posttest non equivalent control group design. There is an experimental group (where students were taught using guided scoring strategy) and a control group (where students were taught using conventional teaching method). The design is presented thus:

$\underline{\mathbf{Y^b \quad x \quad Y^a}}$

$Y^b \sim x \quad Y^a$

y^b = Measurement taken before treatment (pretest)

y^a = Measurement taken after treatment (posttest)

x = Guided Scoring instructional strategy

-x = Conventional chalk-talk approach

This study was carried out in Ebonyi state of Nigeria. Two co-educational secondary schools were drawn for this study through simple random sampling. One of the mixed schools was assigned to treatment group while the remaining one was assigned to the control group through the toss of a coin. In each school that was drawn for this study all the intact classes of SSII were used for the study. The researcher used Algebra Achievement Test (AAT) for data collection. The Algebra Achievement Test is a 20-item essay type questions developed by the researcher from the content area used for the study. The items were drawn using a table of specification from the contents that were covered during the experiment

The Algebra Achievement Test (AAT) was subjected to both face and content validation. The instruments were face validated by three specialists in measurement and evaluation and two mathematics educators. They screened the items in terms of relevance, suitability, clarity and coverage. Table of specification was used to subject the AAT to content validation. The Algebra Achievement Test was subjected to test of reliability using the Kendal's W. The Kendal's' Coefficient of Concordance (W) was deemed most appropriate because the test is of the essay type and was scored by different teachers. Using five scorers on five essay scripts the researcher got Kendall's estimate of inter-rate reliability (W) of 0.61.

2.2. Experimental Procedure

Two instructional strategies were used for the study. Guided scoring instructional strategy was used in teaching the treatment group, while the conventional (chalk-talk) strategy was used in teaching the control group. The two groups are identical in terms of content that were taught and instructional objectives. The researcher used the mathematics teachers in the school and also trained them on how best to use the strategies. The only difference between the two groups is that while guided scoring is a part of instruction in the treatment group and done by the students under the guidance of the teachers, the control groups were evaluated by the teacher after the instruction.

At the onset of the experiment a pre-test was administered to both the treatment and control groups. The mathematics teachers in the sampled schools acted as researcher's assistants. The experiment was carried out during normal school hours using the school timetable. At the end of the experiment which lasted for eight weeks, the researcher administered the post test to the subject in the two groups. The pretest and the post-test were the same for both groups. The data collected from the pretest and posttest were used in answering research questions and testing the hypotheses. Mean and standard deviation were used to answer research questions while ANCOVA was used to test the hypotheses at 95% confidence level.

2.3. Control of Extraneous Variable

The researcher adopted the following procedure to ensure that extraneous variables which may introduce bias into the study are controlled.

(a). *Teacher variable*:
In order to control the errors which may arise as a result of teacher difference, the researcher organized a pre-treatment conference for the teachers that were used for the study. Separate conferences were conducted for teachers in the two groups (experimental and control). The conference helped to establish a common instructional standard among the instructors and the researcher monitored the teachers to ensure that they adhere strictly to the specifications of the manuals. The regular mathematics teachers of the schools (treatment and control) groups were used

(b). *Instructional situation variable*:
To ensure that instructional situation is the same for all the schools the researcher issued instructional guides to the teachers in each group. The teaching was conducted in all classes of SS II in the various schools that were used for the study. This was done to avoid Hawthorne effect.

(c).*Inter-group variable:*
Because intact classes were used for the study, it implies that initial equivalence is impossible for the treatment and control groups. In order to control for errors that could have arisen in comparing effects of treatment on two unequal groups the researcher employed Analysis of Co-Variance (ANCOVA) in analyzing the relevant data.

(d), *Subject Interaction*:
The researcher did not select treatment and control group from the same school to ensure that the students in the treatment and control groups do not mix up at all. This is to reduce the errors that might may arise from the interaction and exchange of ideas among research subjects from the two groups and further eliminates the possibility of a John Henry Effect.

3. Results
The result of data analysis is based on the three research questions and three null hypotheses that guided this study.

3.1. Research Questions
Research Question 1
What is the effect of the guided scoring instructional strategy on the mean achievement scores of students in algebra?
Data obtained for the treatment and control groups for both the pre and post tests were used to answer this research question. Summary of result is shown in Table 1.

Table 1: *Mean achievement scores of students taught algebra with guided scoring strategy and conventional teaching strategy.*

Label	Mean	Std Dev.	Cases
Guided scoring	65.827	14.2520	81
Conventional method	36.4219	18.9241	64

Summary of result presented in table 1 revealed that guided scoring strategy is superior to the conventional strategy in fostering students' achievement in algebra. The guided scoring package yielded a mean achievement score of 65.82 with a standard deviation of 14.25 while the conventional package yielded a mean of 36.42 and a standard deviation of 18.92.

Research Question 2:
What is the effect of the guided scoring instructional strategy on the mean achievement scores of male and female students in algebra?
To answer this research question, mean scores and standard deviations of male and female students in the treatment group were computed and presented as shown below.

Table 2: *Mean Achievement scores of male and female students taught Algebra using guided scoring Approach.*

Label	Mean	Std Dev.	Cases
Male	53.4198	22.2962	81
Female	52.1250	21.7836	64

Table 2 shows that male students taught algebra using guided scoring strategy had a higher mean score than the female students taught algebra using the same method. The male students had a mean score of 53.42 with standard deviation of 22.29 while the female students had a mean score of 52.12 with standard deviation of 21.78.

Research Question 3:
What is the interaction effect of gender and teaching methods on students' mean achievement scores in algebra?
Data obtained for males and females in both the treatment and control groups were used to answer this research questions. Summary of result is presented in Table 3

Table 3: *Summary of interaction effect of gender and teaching method on students' mean achievement scores in algebra*

Gender Groups	Adjusted Mean for Treatment Group	Adjusted Mean for Control Group
Males	66.134	39.026
Females	65.47	32.615

Summary of result presented in table 3 reveal that there is no interaction effect of gender and teaching method on students' mean achievement scores in algebra. Result presented in the table indicated that guided scoring approach is superior to the conventional approach at the two levels of gender (male and female).

3.2. Hypotheses

HO_1: *There is no significant difference in the mean achievement sores of students taught algebra using guided scoring strategy and those taught using conventional strategy.*

HO_3: *There will be no statistically significant interaction between gender and instructional strategy on students' mean achievement in algebra.*

These two hypotheses were tested using Analysis of Co-Variance. Summary of the analysis for these two null hypotheses is shown in table 4.

Table 4: *Analysis of Co Variance for Students Overall algebra Achievement scores by teaching methods and by gender*

Source of Variation	Sum of Square	DF	Mean Square	F. Calculated	F_{cv}
Covariates	65.402	1	65.402	0.242	
Main effects	31571.527	2	15785.764	58.503	
Method	31489.789	1	31489.789	116.703	3.91
Gender	254.778	1	254.778	0.944	
2-way interactions (Method x gender)	311.898	1	311.898	1.156	3.91
Explained	3194.827	4	7987.207	29.001	
Residual	37775.835	140	269.827		
Total	69724.662	144	484.199		

For hypothesis 1, the ANCOVA table shows the F-cal 116.703 is greater than the critical value (3.91) at an alpha level of 0.05. The decision rule is to reject the null hypothesis when the calculated value exceeds the critical value at a given probability level. Since the calculated value is greater than the critical value, the null hypothesis was rejected. The researcher, therefore, concludes that there is a significant difference in the mean achievement scores of students taught algebra using the guided scoring strategy and those taught algebra using the conventional strategy.

For hypothesis 3, result in table 4 reveals that for two the way interaction, the F-cal is .1.156 while the critical value at 5% probability level is 3.91. Based on the decision rule, the researcher upholds the null hypothesis and concludes that there is no significant interaction between gender and instructional approach on students' mean achievement in algebra.

HO_2*: There is no significant difference in the mean achievement scores of male and female students who were taught algebra using guided scoring strategy*

This hypothesis was also tested using the Analysis of Co-variance. Summary of result is shown in Table 5

Table 5: *Analysis of covariance (ANCOVA) for the mean achievement scores of students in the treatment group by gender*

Source of Variation	Sum Of Square	Df	Mean Square	F. cal	F.cv
Covariates	131.505	1	131.503	.636	
Main effects	.674	1	.674	.003	
Gender	.674	1	.674	.003	3.96
Explained	132.177	2	66.089	.320	
Residual	16117.403	78	206.633		
Total	16249.580	80	203.120		

For hypothesis 2, table 5 reveal that F-cal (.003) is less than the significance of F (3.96) at alpha level of 0.05. Since the calculated value is les than the critical value at the given alpha level, the null hypothesis is accepted. The researcher, therefore, upholds the null hypothesis and concludes that there is no significance difference in the mean achievement score of male and female students taught algebra using the guided scoring approach.

3.3. Summary of Results

Results presented in this chapter reveal the following:

(a). Guided scoring instructional strategy fostered higher achievement in algebra than the conventional teaching

strategy. Guided scoring instructional strategy therefore is superior to conventional teaching strategy in facilitating achievement among students.

(b). The difference in the mean achievement scores of male and female students taught algebra using the guided scoring instructional strategy is not statistically significant.

(c). There is no significant interaction between gender and instructional approach on students mean achievement in algebra.

4. Discussion

The results of this study indicated that students taught algebra using guided scoring instructional strategy performed significantly better than students taught using conventional teaching method. In other words the treatment group had higher mean achievement score than the control group taught the same topic using conventional teaching method. The findings of this study is in agreement with the earlier study of Brown (2004) who stated that guided scoring instructional approach allows students to enjoy the service of ownership and direct involvement in judging the quality of instruction and progress. This is also in consonance with the findings of Topping (2003) that guided scoring instructional strategy promotes critical thinking, enhances learning and proper understanding of evaluation criteria.

Summary of data analysis also reveals that male students achieved better than their female counterparts in the treatment group. Although the achievement of the male students in the algebraic expression test is higher than those of their female counterparts, the test of significance revealed that the difference is not statistically significant. This agrees with the findings of Wilson and Hart (2001) and Reese, Milles, Mazzo & Dossey (1997). The study confirms that guided scoring instructional approach is good for the males as well as female students.

Summary of results further revealed that there is no interaction between gender and teaching approach on students' achievement in algebra. This study indicates that guided scoring instructional strategy is superior to the conventional instructional strategy at the two levels of gender in fostering achievement. Although the goal of research in treatment interaction is to find significant disordinal interaction between alternative treatments and personal variable, it must be emphasized here that any approach which yields a no interaction is cost effective and better in all ramification. With this in mind, one may begin to appreciate the worth of the guided scoring instructional strategy both in its superiority over the conventional instructional strategy and its ability to accommodate both males and female students in fostering achievement in algebra.

5. Recommendations

Based on the findings of this study, the researcher made the following recommendations:

i. Both primary and secondary school mathematics teachers should be encouraged to adopt guided scoring instructional strategy as part of their teaching method.

ii. State and federal government should encourage and sponsor in-service training for mathematics teachers on the tenets of guided scoring institutional approach.

iii. The government in collaboration with curriculum developers and mathematics teachers should review the existing curriculum and integrate the basic tenets of the guided scoring instructional strategy in the curriculum.

References

Abonyi O. S and Ugama J. O (2005). Effects of traditional African Mathematical Games on students interest and achievement in mathematics. *Ebonyi State University Journal of Education* 3 (1) 173 - 185

Airagin, P.W (1997) *Classroom assessment*. New York: MacGraw- Hill.

Ainsworth, I & Viegut, D. (2006). *Common Formative Assessment.* California: Corwin Publishing Company.

Alio, B.C. (1997). Polya's problem solving strategy in secondary school studies achievement and interest in mathematics. *An unpublished Ph.D thesis.*

Boyer, B. (1991). *A history of mathematics.* New York: Dover Publications.

Brown H.D (2004) Language Assessment and Principles of Classroom Practices. New York: London

Eliot, N.& Higgen. A (2005). Self and peer Assessment. Does it make a difference to student group work? *Nurse Education in practice* 5, 40-48

Emmos, J.J. (2004). Algebraic process for every day living. A paper presented at the MAN annual conference Usman Danfodio University Sokoto, Every Research centre, August 28th Sept. –-2nd October.

Hoyes, M.I (2004) Assessment of Team work in Higher Education collaboration study. *Journal of Asynchronous learning* Network (1)2.

John, C.K (2006) improving the teaching and learning of mathematics at junior sec. school level. *A paper* presented at a senior class of ABU Zaira post graduate students. Faculty of Edu, Nov 14th 2006.

Kwok (2008). Students perception of peer evaluation and teachers role in serminar discussion. http://e-flt.nus.edu.sg/vsn1 2008/Kwok. htm.

Mark, O.O. (2008). Linear inequality model for effective management decisions. *Journal of Issues on Mathematics 101)* 87-91.
Onugwu, J.F. (1991). '*Identification of Kinds of Errors Secondary school Students make in Solving Problems in Mathematics*" Unpublished M.Ed. Thesis, University of Nigeria, Nsukka.
Orogwu, E.O. (2006). Instructional sequence to teaching of number base. *Journal of issues on mathematics 12 (1-2).*
Topping, K (2003). Self and peer Assessment in schools and university. Viability, vali
Ugama, J.O. (2009) strategies for effectives teaching and learning of number and Numeration –ethno mathematics Approach. Journal of issues on mathematics. *The Annual publication of mathematics parnel of the Science Teachers Association of Nigeria* 244-255.
West African Examination Council (2005). *Chief Examiners Report.* Lagos: WAEC.
West African Examination Council (2007). *Chief Examiners Report.* Lagos: WAEC.
West African Examination Council (2008). *Chief Examiners Report.* Lagos: WAEC.
West African Examination Council (2010). *Chief Examiners Report.* Lagos: WAEC.
West African Examination Council (2011). *Chief Examiners Report.* Lagos: WAEC.
Wilson, P.S; & Hart, L.E (2001) Teachers as researchers: understanding gender issues in mathematics education in W.G. scada, J.E, Jacobs, J.R Becker &G.F. Gilmer (Eds), changing the faces of mathematics: perspective, on gender PP (43-57) Reston. V.4: National council of Teachers of mathematics.
Wilkipedia (20l0). The free Encyclopedia. http://en.wikipedia.org/wiki/Main_Page

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