Homogeneous Ability Grouping and Academic Perfomance of Secondary School Students of Different Ability Levels in Algebra in Adavi, Kogi State - Nigeria

By
Idris Ibrahim Omeiza
&
Umar Aminu Ginga
Institute of Education
Ahmadu Bello University, Zaria – Kaduna State

Abstract

This study compared Algebraic performance of senior secondary school students in a homogeneous ability grouping in Adavi LGA Kogi State. Survey design was used and two classes consisted of 110 SS II students from two randomly selected secondary schools were used as sample. Three (3) hypotheses were formulated to direct the study. Algebraic Performance Test (APT) was used to collect data from the sampled schools. Data collected were analyzed using t-test independent, at $P \leq 0.05$*. The result indicated that there is no significant difference in the mean performance score between high ability level students taught algebra in between-class ability grouping and those in within-class ability grouping but significant difference exist between the mean performance score of: medium ability level students taught algebra in within-class ability grouping and those in between-class ability grouping in favour of the later and likewise low ability level students taught algebra in within-class ability grouping and those in between-class ability grouping in favour of the former. It is concluded among others that the two homogeneous ability grouping (within-class and between-class) are viable for teaching high ability level students in algebra as they have a close to call performance in them. It is recommended among others that mathematics teachers in senior secondary schools should incorporate the combination of between-class and within-class ability grouping models for teaching algebra in class rooms to pave way for the high ability level students to work at their own rate in the former and be able to render assistance to the lower ability level students in the later.*

Keywords: *Academic Performance, Ability Levels, Homogeneous Ability Grouping, Within-Class Ability Grouping, Between Class Ability Grouping, Algebra.*

Introduction

Homogenous Ability grouping involves separating students into groups for instruction according to their perceived same academic abilities (Biafora & Ansalone, 2018). It was further pointed out that this separation can be carried out in two modes. Either separating them into groups such that students of same academic ability stay in the same group all in the same class called within-classes ability grouping or it can be a structural adaptation in which students of higher academic ability are placed in separate classes from their lower performing peers called between-class ability grouping. The students' prior academic achievement according to Archbald, Glutting and Qian (2019) is usually the determining factor in whether students are placed in the higher performing group or the lower ones.

Furthermore, Talca (2007)_in Idris (2016) categorized students into three ability levels in relation to teaching-learning situation using students' previous test or examination scores as index of categorization. These are: Low ability level learners (L) whose academic potentials are judged below average while their performance is described as poor and their test score ranges from 0 to 49; Medium ability level learners (M) who are those that can only record

slightly above average academic performance and their test score ranges from 50 to 64; High ability level learners (H) who are those whose academic performance are described as good and their test scores ranges from 65 to 100. Moreover, the theoretical framework of the study hold that instruction can be targeted more efficiently when students are homogeneously grouped and teachers can best meet the needs of students whose abilities, motivation, and aspirations are similar (Gamoran, 2019). Then, the issue of where in homogenous ability grouping (within-class or between-class) do the low, medium and high ability level students excel academically in algebra is the concern of this study.

According to Adu (2016), algebra is a branch of mathematics where letters are used to represent unknown quantities called variable. In another development, this study see algebra as a branch of mathematics concern with unknown variables in mathematical statements such as $ax^2 + bx + c = 0$ where x is an unknown variable, c is a constant (known variable) and a, b are coefficients of x which could be any real number. By convention according to William and Berlinghoff (2020), letters at the beginning of the alphabet (e.g. a, b, c) are typically used to represent constants and those toward the end of the alphabet (e.g. x, y, z) are used to represent variables.

Algebraic statements are of different form. When it takes the form: $ax^2 + bx + c$, it is called expression; $ax^2 + bx = c$ *or* $ax^2 + bx + c = 0$ is called equation and $ax^2 + bx + c \geq 0$ is called inequality. Each of these three algebraic statements are classified into different types based on the highest power (exponent or index) of x. When an expression has the highest power of x to be 1, 2, 3, 4… they are called linear, quadratic, quartic, cubic expressions respectively. In the same vein if it is equation, they are called linear, quadratic, quartic, cubic equations and likewise, if it is inequality are called linear, quadratic, quartic, cubic inequalities.

In addition, when the power of a variable is one as pointed out by Anthony (2017) such as $3x^1$, it is written as $3x$. Likewise, when the coefficient of a variable is one, it is usually omitted e.g. $1x^2$ is written x^2. When the exponent of a variable is zero, the result is equivalent to 1 e.g. x^0 is always rewritten as 1. This study is limited to some of the algebraic content as contained in the senior secondary school two (SSII) mathematics Syllabus in Nigeria such as: algebraic fractions; quadratic and simultaneous equations.

Moreover, series of studies had been conducted on homogeneous ability grouping and academic performance of secondary school students. The study conducted by Gregory (2016) Linchevski and Kutscher (2016) pointed out that there was significant difference between the mean score of within-class low ability level students and between-class low ability level students in favour of the later and likewise between the mean score of within-class medium ability level students and between-class medium ability level students infavour of the former. The result also revealed that the difference between the mean score of within-class high ability level students and between-class high ability level students was significant. But contrary results were obtained by Totten and Bocso (2018); Emily and Jay (2020) whose study showed that high ability level students in between-class ability grouping performed better than those in within-class ability grouping though their mean scores were not significantly differ. Also the medium ability level students in between-class ability grouping were ahead of their counterparts in within-class ability grouping significantly in academic performance while low ability level students in within-class ability grouping performed significantly higher than those in between-class ability grouping. This study examined where in the two modes of homogenous ability grouping the low, medium and high ability level students in secondary school flourish academically in algebraic area of mathematics.

Objectives of the Study

This study compared algebraic performance of low, medium and high ability level students in within-class ability grouping with those in between-class ability grouping for viability option.

Research Question

The research question below was raised to guide the study:

In which of the homogenous ability grouping (within-class ability group or between-class) do low, medium and high ability level students perform better when taught algebra?

Hypotheses

The following null hypotheses were formulated for testing at 0.05 levels of significance:

Ho_1: There is no significant difference in the mean performance score between low ability level students taught algebra in within-class and those taught in between-class ability grouping.

Ho_2: There is no significant difference in the mean performance score between medium ability level students taught algebra in within-class and those taught in between-class ability grouping.

Ho_3: There is no significant difference in the mean performance score between high ability level students taught algebra in within-class and those taught in between-class ability grouping.

Methodology

This study used survey design which according to Nworgu (1991) in Idris (2021) involves collection of data at current status for description of phenomena, without deliberate effort to control the variables. Data collected in respect of the study were students' mathematics score from a test conducted by the researcher. Students' previous mathematics examination scores were used to classify them into High (H), Medium (M) and Low (L) ability levels and consequently organized into the two modes of homogeneous ability groupings: within-class ability grouping where each of the low, medium and high ability level students stayed separately in the same group for algebraic instruction all in the same class and between-class ability grouping where the low, medium and high ability level students were taught algebra separately in different class. Some selected SS II algebraic topics as earlier listed were taught to students in the two modes of homogeneous ability groupings. This was done to control the influence of extraneous variables such as teachers' teaching method and qualification from one school to the other. They were then tested to determine which of the grouping modes compared is more viable for each ability levels in the teaching of algebra.

The target population of this study consisted of all the Public Senior Secondary two (SSII) students which had a population of 2, 520 from 12 established public senior secondary schools in Adavi LGA, Kogi State for 2023/2024 academic session. Two classes (one for within-class ability grouping and one for between-class ability grouping) from two randomly selected senior secondary schools using balloting method were used. These include 52 students (L = 26, M = 17, H = 9) from School A where within-class ability grouping was implemented and 58 students (L = 28, M = 18, H = 12) from School B where between-class ability grouping was implemented, making a total of 110 students. These constitute the sample for the study. The sample technique adopted to select the study subjects was cluster. This was done by randomly

selecting one class each from the cluster arm of classes available in the two randomly sampled schools from the population.

Data collection were through the use of 50-item multiple choice objective questions tagged Algebraic Performance Test (APT) to determine which of the grouping modes compared is more viable for teaching algebra for each ability level than the other. Marking scheme was prepared for scoring the test items. Table of specification was constructed for the development of this instrument.

The content of APT were assessed and corrected by two mathematics Lecturers who are both professors in mathematics education, two PhD mathematics science lecturers who are senior Lecturers and two mathematics teachers at the secondary school level who are graduates and had 12- and 15-years teaching experience respectively. About 60 multiple choice questions were sent out to the experts but were scaled down to a 50 test items. Ten of the questions were not selected because their levels of difficulties were either too low or too high. Final copy of the instrument was produced with strict adherence to the observation made by the experts. The APT was field tested on a sample of 40 SSII students in a school that was not part of the study whose student's demography in terms of age and class level were similar to the students involved in the main study. The instrument has reliability coefficient of 0.73 using test-retest method and Pearson Product Moment Correlation for data analysis.

The researcher with the help of the mathematics teachers in the selected schools administered the APT to the subjects. The answer scripts collected from the test of the two groups were marked and scored in percent. The data were pooled together but segregated according to groupings (within-class ability group vs. between-class ability group). The data were analyzed using t-test independent to test the formulated null hypotheses, *at* $P \leq 0.05$.

Presentation of Results

The data obtained from the study were analyzed using version 20 of the Statistical Packages for Social Sciences (SPSS). This was done to address the research questions and test the null hypotheses using the appropriate descriptive and inferential statistical tools respectively as follow:

Table 1: Summary of Mean Performance and Standard Deviation of Students Scores in Different Ability Level with respect to Homogeneous Ability Grouping

Ability Level	Ability Grouping	N	Mean ($\bar{x}$)	δ	Mean Diff.
High	Within-class	9	56.52	3.13	1.48
	Between-class	12	58.00	2.96	
Medium	Within-class	17	44.67	4.02	-4.38
	Between-class	18	49.05	3.77	
Low	Within-class	26	32.25	5.32	4.80
	Between-class	28	27.45	5.78	

The analysis in Table 1 showed that the mean score of within-class high ability level and between-class high ability level students are 56.52 and 58.00 with difference of 1.48 in favour of between-class high ability level students. Other results in the same manner occurred between: within-class medium ability level and between-class medium ability level students with mean score 44.67 and 49.05 respectively and a difference of -4.38 in favour of between-class medium ability level students; within-class low ability level and between-class low ability level students with mean score 32.25 and 27.45 respectively and a difference of 4.80 in favour of between-class medium ability level students. These results indicate that the high and medium ability level students did better in between-class ability grouping while low and medium ability level students excel in within-class ability and between-class ability grouping respectively. In order to establish if the mean differences are statistically significant, inferential statistics was used to test the null hypotheses.

To test the formulated null hypotheses Ho_1, Ho_2 and Ho_3, t-test independent was used as presented in Tables 2, 3 and 4.

Ho_1: There is no significant difference in the mean performance score between high ability level students taught algebra in within-class and those taught in between-class ability grouping.

Table 2: t-test independent Analysis of High Ability Level Students' Mean Performance Score with respect to Homogeneous Ability Grouping

Ability Level	Ability Grouping	N	Mean ($\bar{x}$)	δ	df	t-value	P-value	Remark
High	Within-class	9	56.52	3.13	19	80.97	231	**
	Between-class	12	58.00	2.96				

** Not Significant at P ≥0.05

The result in Table 2 showed no significant outcome P = 0.231 > 0.05 alpha level. The null hypothesis Ho_1 is therefore retained. These imply that there is no significant mean performance scores difference between high ability level students taught algebra in within-class and those in between-class ability grouping.

Ho_2: There is no significant difference in the mean performance score between medium ability level students taught algebra in within-class and those taught in between-class ability grouping.

Table 3: t-test independent Analysis of medium Ability Level Students' Mean Performance Score with respect to Homogeneous Ability Grouping

Ability Level	Ability Grouping	N	Mean ($\bar{x}$)	δ	df	t-value	P-value	Remark
High	Within-class	17	44.67	4.02	33	82.59	.001	*
	Between-class	18	49.05	3.77				

* Significant at P<0.05

The result in Table 3 revealed a significant difference P = 0.001< 0.05 alpha level. The null hypothesis Ho_2 is therefore rejected. This imply that: there is significant mean performance

scores difference between medium ability level students in within-class and those in between-class ability grouping. This significant difference is infavour of medium ability level students in between-class ability grouping.

Ho_3: There is no significant difference in the mean performance score between low ability level students taught algebra in within-class and those taught in between-class between-class ability grouping.

Table 4: t-test independent Analysis of low Ability Level Students' Mean Performance Score with respect to Homogeneous Ability Grouping

Ability Level	Ability Grouping	N	Mean ($\bar{x}$)	δ	df	t-value	P-value	Remark.
High	Within-class	26	32.25	5.32	4	24.18	.012	*
	Between-class	28	27.45	5.78				

* Significant at P<0.05

The result in Table 4 showed a significant difference P = 0.012 < 0.05 alpha level. The null hypothesis Ho_3 is therefore rejected. This imply that: there is significant mean performance scores difference between low ability level students in within-class and those in between-class ability grouping. This significant difference is infavour of low ability level students in within-class ability grouping.

Discussion

The result of the t-test analysis of data in Table 2 showed that significant difference was not established between within-class high ability level and between-class high ability level group though, the high ability level students in between-class ability group performed better in algebra. This could be link to the fact that the high ability level students in between-class ability group were together in a separate class without the medium and low ability level students around who could be demanding for assistance, contrary to what is obtainable in within-class ability grouping where the high, medium and low ability level groups stayed together in the same class for instruction. Nevertheless, the no significant outcome signify that the high ability level students can excel academically in algebra in both the within-class and between-class homogenous ability grouping. This finding contradicted the result from the study of Gregory (2016) who claimed that, the difference between the mean performance score of within-class high ability level and between-class high ability level students was significant but agreed with that of Emily and Jay (2020) whose study revealed that there was no significant difference between the mean performance score of the two groups of students.

The result of the t-test analysis of data in Table 3 revealed a significant outcome between the mean performance scores of medium ability level students in within-class and between-class ability grouping in algebra in favour of between-class medium ability level group. This result disagrees with the study of Linchevski and Kutscher (2016) who reported a contrary view. However, it is a confirmation of what is obtained in the study of Totten and Bosco (2018) which pointed out that between-class medium ability level group performed significantly higher than within-class medium ability level group.

Also, the t-test analysis of data in Table 4 indicated a significant outcome between the performance of low ability level students in within-class and between-class ability group in algebra in favour of within-class low ability group. These findings could be attributed to the

presence of higher ability level students in within-class ability grouping who stimulated, motivated and inspired low ability level students. The finding disagreed with what is obtained in the study of Linchevski and Kutscher (2016) but in accord with the finding of Emily and Jay (2020) whose result was in line with the outcome of this study.

Conclusions

From the findings of the study, it was concluded that: the two homogeneous ability grouping (within-class and between-class) are viable for teaching high ability level students in algebra as they have a close to call performance in them; the medium ability level students in between-class ability group performed significantly higher than their counterpart in within-class ability group hence, between-class ability grouping is a viable option for teaching algebra to medium ability level students and also, the within-class ability grouping is more viable for algebraic instruction than between-class ability grouping for low ability level students as they were ahead significantly in mean performance score in algebra in the former.

Recommendations

It was recommended based on the findings from the study that:

- Mathematics teachers in senior secondary schools should incorporate the combination of between-class and within-class ability grouping model for teaching algebra in class rooms to pave way for the high ability level students to work at their own rate in the former and be able to render assistance to the lower ability level students in the latter.
- Between-class ability grouping arrangement should be adopted for teaching algebra to medium ability students while within-class ability grouping should be a viable option for teaching algebra to the low ability level students in senior secondary schools.

References

Adu, D.B. (2016). Comprehensive mathematics for senior secondary schools. Lagos: Johnson Publishers Plc.

Anthony, W.K. (2017). Advanced algebra: along with a companion volume basic algebra. New York: Springer.

Archbald, D., Glutting, 1. & Qian, X. (2019). Getting into honors or not: An analysis of the relative influence of grades, test scores, and race on track placement in a comprehensive high school. American Secondary Education, 37(2), 65 – 81.

Biafora, F. & Ansalone, G. (2018). Perceptions and attitudes of school principals towards school tracking: Structural considerations of personal beliefs. Education, 128(4), 588 – 602.

Emily T. & Jay F. (2020). Effects of ability grouping on math achievement of third grade students. Paper presented at Georgia educational research association annual conference Savannah, Georgia from October 20 – 24, 2014.

Gamoran, A. (2019). Tracking and inequality: New directions for research and practice (WCER Working Paper No. 2009-6) Madison: University of Wisconsin-Madison.

Wisconsin Center for Education Research. Retrieved July 21, 2011, from http://www.wcer.wisc.Edulpublicationslworkingpapers. Php.

Gregory, R. P. (2016). Streaming, setting and mixed ability grouping in primary and secondary school: some research findings. Review of Educational Research, 57(2), 415 – 435.

Idris, I. O. (2016): Impacts of concept mapping strategy on attitude, retention and performance of students of varied ability in algebra. An Unpublished Ph. D thesis. department of science education, Ahmadu Bello University, Zaria.

Linchevski, L. & Kutscher, B. (2016). Tell me with whom you're learning, and I'll tell you how much you've learned: mixed-ability versus same- ability grouping in mathematics. Journal for Research in Mathematics Education, 29(5), 533 – 554.

Talca, T. S. (2007). Curriculum formation and education achievements. Dakar: Longman Press.

Totten, I., & Bosco, K. (2018). The impact of ability grouping in introductory Geology labs. Geological Society of America Abstracts with Programs, 40(3), 163 - 178.

William P. & Berlinghoff, F. Q. (2020). *Math through the ages: a gentle history for teachers and others* New York: MAA.