EFFECT OF TWO MODES OF LESSON STUDY ON SENIOR SECONDARY STUDENTS' ATTITUDE IN ALGEBRA IN KAFANCHAN EDUCATION ZONE OF KADUNA STATE, NIGERIA

Daniel John Dogo
Department of Mathematics Kaduna State college of Education, Gidan Waya, Nigeria

Abstract
This study investigated the impact of two modes of lesson study on senior secondary students' attitude in algebra in Kafanchan Education Zone of Kaduna State. The study adopted a quasi-experimental, non-equivalent pre-test, post-test, time series research design. Two objectives, 2 research questions and 2 hypotheses guided the study. The instruments used for the study were Algebra Attitude Rating Scales (AARS) and Planned Lessons Observation (PLO). The reliability coefficient obtained using Cronbach Alpha Coefficient for the AARS and was0.85. Sample for the study was 167 students selected from 3 coeducation senior secondary schools using a multi-stage sampling technique. Descriptive statistics of means and standard deviations were used to answer the research question while inferential statistic of ANCOVA was used to test the hypotheses at 0.05 level of significance. The study revealed among other things that the two lesson study modes significantly enhanced positive attitude of students in algebra. The study recommended among other things that the two modes of lesson study should be used in planning and implementing lessons for the various topics in mathematics to improve students' positive attitude in mathematics.

Introduction

The usefulness of mathematics in everyday living cannot be over emphasized, for it is applied in almost everything we do for personal and national development. Kurumeh and Imoko (2008) argue that it is due to its indispensability in nation building that, it is made one of the compulsory subjects at the primary, junior and senior secondary schools of Nigerian education. Mathematics is applied in teaching and learning other subjects. Mathematics has been a pivot which many other subjects revolve especially science subjects (Ezeugwu, 2013). An individual has to be well equipped with the basic knowledge of mathematics in order to effectively apply it in other school subjects like chemistry, physics, biology, economics and geography among others. Kyeleve (2009) posits that prominent in the continuing argument for mathematics in the school curriculum is its central role as a tool or language which opens the door to science.

Iyekekpolor and Bulus (2009) assert that any nation that treats mathematics education of her youths with levity does so at her own scientific and technological peril. Mathematics is believed to have evolved and developed out of human needs to meet up with certain expectations of lives and it holds the mirror of civilization all over the world (Azuka, 2012). Moreover, Agwagah (2013) observes that the overall national development of any nation and building of a healthy, happy and prosperous society cannot be successfully achieved without mathematics.

In view of the above, it is quite imperative for secondary school students to have positive attitude in acquiring mathematical knowledge and skills necessary for application in science learning and to enable them prepare well for real life situations. Apart from enabling the students to acquire essential mathematical knowledge, skills, develop appropriate interest and attitude, the teaching of mathematics has to help them in many other ways (Sidhu, 2006). Teachers and

learners need to be actively involved in the teaching-learning processes and the instructional method in use ought to create opportunity for the required interaction to take place (Eriba & Achor, 2010). Modes of lesson study could also be used in teaching and learning.

Mode is a cycle that starts from defined lesson to observed lesson implementation to reflection/discussion session that identifies areas of lesson modification and revision. In this research work two modes (cycles) are used. In some cases there could be more than two modes depending on students' learning outcomes. Lesson study based on quasi-experimental research design could have two or more modes (cycles) (Easton, 2009). At the end of the second mode of lesson study students are expected to attain a satisfactory learning outcome (for example 80% achievement rates or better).

Lesson study is a professionally development process that Japanese teachers engage in to systematically examine their practices, with the goal of becoming more effective (Lesson Study Research Group, 2014). Lesson study is a teaching improvement process that has origin in Japanese elementary education, where it is a wide spread practice (Easton, 2009).Lesson study could also be defined as a teaching process that involves a group of teachers who collaboratively plan a lesson and anyone member of the group teaches the lesson by interacting with the students; the students also interacting among themselves in peers or groups; while other teachers observe and gather evidence on students' learning outcomes; this is then followed by a reflection session after the lesson to critique and revise the lesson and teach the revised lesson to the same class or another by the same teacher or another.

Lesson study requires teachers to work collaboratively to strengthen a given lesson until it has been refined as much as possible and then teach it to get powerful data about how well the lesson works (Easton, 2009). Working in a small group, teachers collaborate with one another, meeting to discuss learning goals, to plan actual classroom lesson (called a "research lesson"), to observe how it works in practice, and then to revise and report on the result so that other teachers could benefit from it (Lesson Study Research Group, 2014). A unique characteristic of lesson study is that it provides an opportunity for teachers to carefully examine the students' learning and understanding of process by observing and discussing actual classroom practice (Human Resources Development Working Group, 2015). Lesson study could affect attitude of students in algebra.

Algebra is a branch of mathematics in which symbols, usually letters of alphabet, represent numbers or numbers of a specified set and are used to represent quantities and to express general relationship that holds for all elements of a set (Adeniji & Ibrahim, 2015). Algebra could be seen as that branch of mathematics in which quantities are generalized and expressed in symbols. Algebra is a foundation and the language system on which higher order mathematics, sciences, technology and engineering courses are built (Musen, 2010). The author also asserts that success in algebra opens door to more advanced mathematics. Olusunde (2013) reiterates that active engagement is said to aid understanding and improve academic performance, attitude and classroom practice. Poor attitude of students may also contribute to having difficulties in algebra.

Attitude towards mathematics plays a crucial role in its teaching and learning, and could influence positively or negatively understanding of it by the students. Michael and Gwyneth (2007) define attitude as someone's opinions or feelings about something. The conceptions, attitudes and expectations of students regarding mathematics and mathematics teaching have been considered to be a very significant factor underlying their experience and achievement (Farooq & Shah, 2014). More so, ideas, attitudes and beliefs acquired at an early stage are

usually difficult to change at adulthood (Kurumeh & Imoko, 2008). There are several types of attitude and these include motivation, self-concept, enjoyment, anxiety and confidence among others (Kyeleve & Williams, 2003). Students' enjoy ability of algebraic activities are used in teaching and students' confidence is developed from performing algebraic tasks (Kyeleve, 2004).

Statement of the Problem

Most students studying algebra have poor attitude in dealing with multi- term expressions as a single unit (Clements & Ellerton, 2006). Again, the students are generally not aware of the structure underlying the manipulation they perform in algebra. Students also have poor attitude in the development of abstract algebraic skills. The students' procedural knowledge is fraught with unsystematic errors indicating an absence of knowledge of structural features of algebra due to poor attitude. In spite of regular organization of conferences, seminars and workshops for professional development of mathematics teachers in pedagogical content knowledge, the attitude of students in algebra is still not encouraging (Dogo, Kyeleve & Kurumeh, 2018). Efforts in trying to improve students' attitude in algebra using the existing conventional methods of teaching it have not yielded the desired result (Mohammed & Kurumeh 2014). The West Africa Examination Council (WAEC) Chief Examiner's reports of (2006-2014) and National Examination Council (NECO) Chief Examiner's reports of (2006- 2015) in Nigeria indicate that students' performance in mathematics has been poor. This was why the study on the effect of two modes of lesson study on senior secondary students' attitude in algebra was embarked upon to investigate to see if lesson study could improve students' attitude in algebra.The two modes are planned lesson mode (PLM) which is the first cycle and revised planned lesson mode (RPLM) that is the second cycle.

Purpose of the Study

The purpose of this study was to determine if lesson study could improve senior secondary (SSI) students' attitude and achievement in algebra. Specifically the study sought to:

1. Ascertain the effectiveness of Teacher-Centred Method (TCM), Planned Lesson Mode (PLM) and Revised Planned Lesson Mode (RPLM) on attitude of SSI students in algebra.
2. Determine the interactive effect of gender and instructional methods on attitude of students in algebra.

Research Question

The following research question was provided to guide the study.

1. What are the mean attitude ratings of SSI students taught algebra with TCM, PLM and RPLM?
2. What is the interaction effect size of gender and instructional methods on attitude of students in algebra?

Hypotheses

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

H_{O1} There is no significant difference in the mean attitude ratings of SS students taught algebra using TCM, PLM and RPLM.

H_{O2} There is no significant interaction effect between gender and instructional methods on attitude of SS students in algebra.

Methodology

Quasi-experimental design was used in conducting this research. Specifically, it was a non-equivalent pre-test, post-test time series experimental-control group design. This design was adopted because it is not possible to completely randomize the subjects into the experimental and control groups. The area of study for this research was Kafanchan education zone of Kaduna State, Nigeria. The zone comprised four local government areas (LGAs) namely: Jaba, Jema'a, Kaura and Zongon-Kataf. The target population was 5,226 senior secondary one (SS1) students, out of which 3, 545 were boys and 1,681 were girls. The population was from all the 49 coeducational SS1 students.

A sample of 167 students was selected through a multi-stage sampling technique and used for this study. In the first stage, three LGAs were selected out of the four LGAs in the study area by random sampling technique. The Random sampling technique was used because each element of the population had equal and independent chance of being included in the sampling.

Purposive sampling technique was used at the second stage to select one co-educational secondary school with at least one SS1 class in each of the LGAs selected in the first stage. The purposive sampling technique was used because it ensured that one co-educational secondary school was selected from each LGA. At the third stage, one intact class was selected from each of the three schools selected at the second stage by random sampling technique. If any of the selected schools had only one SS1 class, the class automatically was selected. The study therefore, had three intact classes. Sampling technique was used to select one class for the control group out of the three intact classes. Similarly, a random sampling technique was equally used to select one class out of the remaining two intact classes for the PLM group. The remaining intact class was used for the RPLM group.

Three instruments were developed by the researcher and used for the research. The instruments were Lesson Understanding Written Statements (LUWS), Algebra Attitude Rating Scale (AARS) and Planned Lessons Observation (PLO). The LUWS instrument was made up of five items for each of the experimental lessons. Each item was generated from each learning activity of each of the experimental lessons. Each item of the instrument tested the understanding of each activity by the students. The instrument was administered at the end of each of the experimental lessons. Each student responded to each item by writing True (T) or False (F) against it. The AARS consisted of one instrument with two sections which were algebra enjoy ability and algebra confident sub-scale. The algebra enjoy ability had 20 items, itemized from 1 to 20 and the algebra confident sub-scale also had 20 items, itemized from 21 to 40. All the items were neutrally framed according to Guttman-type scale (Kyeleve &Williams, 2006). That is to say the items were neither positively nor negatively framed. The AARS items were based on Guttman-type scale of five- point options scored as "Like a lot", "Like a little", "Not bothered", "Dislike a little" and "Dislike a lot". The confident items were also based on Guttman-type scale of five- point options scored as "Very confident", "Confident", "Reasonably confident", "fairly confident", and "Not confident".

The PLO instrument was developed by the researcher. The instrument had a number of activities for each experimental planned lesson. The response to each number of the activities was on a scale ranging from unsatisfactory, fairly satisfactory, satisfactory, quite satisfactoryand very satisfactory with students' learning achievement, general remark and any other observation(s). The research team members responded to the PLO instrument. The responses were used during the reflection session after the presentation of each planned lesson. Data collected and collated were analyzed using descriptive statistics of mean and standard deviation

to answer the research questions asked while Analysis of Covariance (ANCOVA) was used to test the hypotheses formulated at 0.05 level of significance.

Results

The result of the study is presented according to the research questions and hypotheses.

Research Question 1

What are the mean attitude ratings of SSI students taught algebra with TCM, PLM and RPLM

Table 1: Mean Attitudes Ratings and Standard Deviations of SSI Students Taught Algebra with TCM, PLM and RPLM

Group	N	Pre- attitude Mean	σ	Post-attitude Mean	Σ	Mean Gain Within Group
TCM	57	1.57	0.47	2.30	0.24	0.73
PLM	48	1.76	0.48	3.11	0.47	1.35
Mean diff. Between Groups		0.19		0.81		0.62
TCM	57	1.57	0.47	2.30	0.24	0.73
RPLM	62	1.83	0.54	4.46	0.66	2.63
Mean diff. Between Groups		0.26		2.16		1.90
PLM	48	1.76	0.48	3.11	0.47	1.35
RPLM	62	1.83	0.54	4.46	0.66	2.63
Mean diff. Between Groups		0.07		1.35		1.28

Data in Table 1 reveal mean attitude ratings with standard deviations of the three groups on a paired comparative basis. Data in the Table also show the mean gain in attitude ratings, for TCM is 0.73, PLM is 1.35 and RPLM is 2.63. Results in the Table also reveal that the mean difference between TCM and PLM groups in the pre-test and post-test are 0.19 and 0.81 respectively; and the mean gain is 0.62. The mean difference between TCM and RPLM groups in the pre-test and post-test are 0.26 and 2.16 respectively; and the mean gain is 1.90. The mean difference between PLM and RPLM groups in the pre-test and post-test are 0.07 and 1.35 respectively; and the mean gain is 1.28. The paired mean gains comparison also shows that TCM is 0.73 and PLM is 1.35; TCM is 0.73 and RPLM is 2.63; PLM is 1.35 and RPLM is 2.63.

Research Question 2

What is the effect is the interaction effect size of gender and instructional methods on attitude of students in algebra?

Table 2: Two-Way ANCOVA for Two Modes of Lesson Study on SSI Students' Attitude Ratings in Algebra Taught With TCM, PLM, RPLM and Interaction Effect Size ofgender and Instructional Methods

Source	Type III Sum of Squares	DF	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	204.70	6	34.11	310.09	0.00	0.92
Intercept	12.11	1	12.11	110.09	0.00	0.05
TPrAR	0.03	1	0.03	0.27	0.60	0.00
Gender	4.16	1	4.16	37.82	0.00	0.02
Group	99.13	2	49.57	450.64	0.00	0.45
Gender * Group	7.93	2	3.97	36.09	0.00	0.04
Error	17.79	160	0.11			
Total	2125.56	167				
Corrected Total	222.48	166				

Data in Table 2 reveal that the interaction effect size of gender and instructional methods on attitude of students in algebra is 0.04.

Hypothesis 1

There is no significant difference in the mean attitude ratings of SSI students taught algebra with TCM, PLM and RPLM.

Results in Table 2 present a summary of Two- Way ANCOVA for two modes of lesson study on attitude ratings of senior secondary students in algebra taught with TCM, PLM, RPLM and interaction effect size of gender and instructional methods. Data in the table reveal that the observed mean difference in the attitude ratings among the groups was significant at $F_{2, 160} = 450.64$, $p = 0.00 < \alpha = 0.05$. Hence, the null hypothesis that there is no significant difference in the mean attitude ratings of students taught algebra with TCM, PLM and RPLM was rejected. The conclusion drawn is that there is a significant difference in the mean attitude ratings among the groups.

Table 3: Turkey HSD Post Hoc Comparison for Two Modes of Lesson Study on SSI Students' Attitude Ratings in Algebra Taught with TCM, PLM and RPLM

(I) Group	(J) Group	Mean Difference(I-J)	Std. Error	Sign.
TCM	PLM	-1.17*	0.12	0.00
TCM	RPLM	-2.30*	0.12	0.00
PLM	RPLM	-1.13*	0.12	0.00

Table 3 shows Turkey HSD post-hoc comparison for two modes of lesson study on senior secondary students' attitude ratings in algebra taught with TCM, PLM and RPLM. The results reveal that the mean difference (I-J) between the two groups TCM and PLM is -1.17* and this is significant at $p=0.00 < \alpha = 0.05$. The mean difference (I-J) between TCM and RPLM was -2.30* and this is significant at $p= 0.00 < \alpha=0.05$. The mean difference (I-J) between PLM and RPLM is -1.13* and this is significant at $p=0.00 < \alpha=0.05$. The conclusion drawn is that there is

significant difference in the mean attitude ratings of students in algebra between the TCM and PLM, between TCM and RPLM; and between PLM and RPLM groups.

Hypothesis 2

There is no significant interaction effect of gender and instructional methods on attitude of SS students in algebra.

The data analysis of Table 2 is used to explain hypothesis 2. The table presents a two- way ANCOVA for impact of lesson study on senior secondary students' attitude to algebra taught with TCM, PLM and RPLM. Results indicate that interaction effect between gender and instructional methods on students' attitude in algebra is significant at $F_{2,\ 160} = 36.09$, $p=0.00 < \alpha=0.05$, $\eta^2=0.04$. Partial eta squared was 0.04 which Cohen (1988) in Pallant (2014) considered a near medium effect. The author classified 0.01 as a small effect, 0.06 as medium effect and 0.14 as large effect. Hence, the interaction effect between gender and instructional methods on students' attitude in algebra is a near medium effect (see Figure for graphical representation).

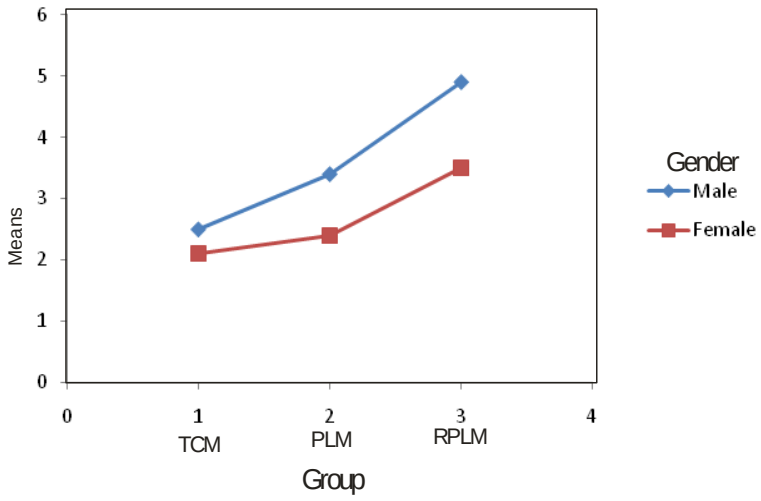

Figure 1: Profile of Students' Mean Attitude Ratings According to Groups by Gender

Figure shows ordinal interaction and so there is significant interaction effect of gender and instructional methods on attitude ratings of students in algebra. This is because the graphs are not absolutely parallel. There is tendency of meeting if one continues to draw the lines.

Discussion of Findings

The study revealed that students in RPLM group developed the best attitude among the three groups. The students in the RPLM group were followed by those in PLM group while the least in terms of attitude were students in TCM group. Students who were taught with meaningful activities in the PLM/RPLM developed far more positive attitude than those taught with TCM. This could be because students in the PLM/RPLM had interactions in the various groups and interactions with the teacher and other important algebraic tasks in class. Furthermore, the presentation of PLM/RPLM improved positive attitude of students to learning algebra, greatly

wiped out fear and hatred of algebra (algebra phobia), generally enjoyed working with algebra and had joy and confidence in ability to work with quadratic expressions and equations. The PLM/RPLM gave students opportunity to experience algebra aesthetically during algebra lessons due to the sharing of feelings, ideas and knowledge in interacting and discussing in various groups. The PLM/RPLM also created inter-subjective level on which schemes of actions, goals and ultimate feelings and emotions are shared.

The findings are in line with the findings of Ng, Koh, Kelly and Yue (2012) who found that students taught with meaningful task attained more positive attitude in mathematics than those in comparison class. This finding is also in agreement with the findings of Lewis, Perry and Hurd (2009) who found that students taught with lesson study exhibited significantly higher positive attitude in algebra. The findings are as well in line with the findings of Waterman (2011) who revealed that students' in lesson study classes showed more enthusiasm in learning mathematics than those in the control group. The findings of this study are also in line with the findings of Mayer (2011) who found that lesson study had positive impact on students' engagement.

Conclusion

The two modes of lesson study offer a framework for outcome based education which is a thrust towards greater learner-centred approach. The two modes of lesson study have also proven to be instrumental in helping teachers plan more for lessons but talk and act less while students learn more by interacting and discussing in various groups. Hence, the persistent poor attitude of Nigerian secondary school students in mathematics especially in algebra need not continue indefinitely. There is hope that with the two modes of lesson study the situation could be changed for the better.

Recommendations

1. The two modes of lesson study should be used in planning and implementing lessons for the various topics in mathematics to improve students' positive attitude in mathematics.
2. The government should make it a policy for lesson study to be a professional instruction mode at the basic education and at the senior secondary levels to improve the positive attitude of students in mathematics in general and algebra in particular algebra.
3. Lesson study should form the basis for improvement of pre and post service training programmes during micro-teaching and teaching practice exercises to help mathematics teachers become conversant with it and prepare well in advance for arousing the interest of students in teaching.

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