INFLUENCE OF TIERED LESSON AND GROUP PERSONALIZATION INSTRUCTIONAL STRATEGIES ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN MATHEMATICS

Fisayo Areelu
Department of Mathematics, School of Sciences,
Michael Otedola College of Primary Education, Epe, Lagos
Mojeed Kolawole Akinsola
Department of Teacher Education, Faculty of Education,
University of Ibadan, Ibadan

Abstract

This study examined the Effects of Tiered Lesson Instructional Strategy (TLIS) and Group Personalization Instructional Strategies (GPIS) on Senior Secondary School Students Achievement in Mathematics. The moderating effects of mathematics anxiety and gender were also investigated. The study adopted the pretest-posttest, control group, quasi experimental design with a 3x3x2 factorial matrix. Three hundred and thirty-seven senior secondary two students from six public schools purposively selected participated in the study. Four null hypotheses were tested at 0.05 significance level. Four instruments were developed, validated and used for data collection. Data were analysed using Analysis of Covariance and Scheffe Post hoc test. The findings showed that treatment had significant effect on students' achievement in Mathematics ($F_{(2,318)}$ =324.73, p<.05). Students exposed to TLIS had the highest post achievement score. The study also revealed that Mathematics Anxiety (MA) had significant effect on Students' achievement in Mathematics ($F_{(3,333)}$=122.54,p<.05). Students with low MA had the highest post achievement score. It also showed that gender had no significant effect on students' achievement in Mathematics. Furthermore, the result of the 3-way interactions showed a significant interaction effects of treatment, mathematics anxiety and gender on students' achievement in Mathematics ($F_{(18,318)}$ = 2.063, p < 0.05). Among the students in the TLIS group, those with low MA had highest post achievement scores. It was concluded that Mathematics teachers should be trained to use tiered lesson and group personalization learning packages in the classroom, since

the strategies are effective in enhancing students' achievement in Mathematics than the conventional method.

Background to the study

A strong background in mathematics is critical for many career and job opportunities in today's increasingly technological society. However, many academically capable students prematurely restrict their educational and career options by discontinuing their mathematical training early in high school (Meece, Wigfield and Eccles, 1990). The choice of subject of study, Mathematics, is guided by the literature. Rene Descartes (1596-1650), a philosopher, argued "that mathematics or the "mathematicised" sciences ensured our understanding of the world" (Nokoe, 2008). Science, to Descartes, relies on the power of mathematics. Nokoe (2008) rejected the tempting arguments of George Berkeley (1685-1753) and David Hume (1711-1776) that mathematics is rooted in bundles of assumptions about infinite desirability in want of any basis in experience. In reaction, Nokoe (2008) had argued that, mathematics carries an optimal degree of consistency, certainty and credibility to guide the Sciences. The great misconception about mathematics is the notion that mathematics is about formulas and computations that need to be memorized. This is worrisome, especially as mathematics is considered as the bedrock of all scientific and technological breakthroughs and advancement of all activities of human developments. It is the only language and culture common to all studies (Uzo, 2002). Mathematics is an expanding and evolving body of knowledge as well as a way of perceiving, formulating and solving problems in many disciplines (Odili, 2011).

Alechenu (2012) described mathematics as the "queen" of the sciences without which it would be difficult for people to study other sciences like physics, chemistry, biology and computer science/information technology. Underscoring the importance of science and technology to national development, he said, "We hope our government will properly address the issue of scientific transformation of our grown dynamics and processes as a nation" (Alechenu, 2012).

As important as the subject is, the tremendous and persistent failures of the Nigerian Students in it (Sanni and Ochepa, 2002; Uloko and Imoko, 2007; Abakpa and Agbo - Egwu, 2008) has remained a major concern to mathematics learning. Learners continue to manifest weak understanding of Mathematical concepts, skills generalization, among others, not only in external examinations but also in classroom exercises (Bot, 2000). This

view is supported by the West Africa Exanimation Council Chief Examiners' Reports 2002-2011 on Senior Secondary School Certificate Examination results (WAEC, 2011) which recorded very low percentage passes in Mathematics at credit level in those years. In addition to the annual reports of the Chief Examiners in Mathematics, Table 1 further attests to students' poor performance in Mathematics between 2002 – 2011 in Nigeria.

Table 1: Analysis of WASSCE in Mathematics Results of May/June 2002 – 2011 in Nigeria.

NUMBER AND PERCENTAGE OBTAINING GRADE							
YEAR	Total Enrolled for Exam	A1-C6 Higher Passes	% Higher Passes	D7-E8 Poor Passes	% Poor Passes	F9 Outright Failure	% Outright Failure
2002	908,235	309,409	34.06	308,369	33.95	290,457	31.98
2003	926,212	341,928	36.91	331,348	35.11	229,878	23.74
2004	832,689	287,484	34.52	245,071	28.22	300,134	34.74
2005	1,054,853	402,982	38.20	276,000	25.36	363,055	34.41
2006	1,181,515	482,123	41.73	366,801	31.55	292,560	25.13
2007	1,249,028	583,921	46.75	333,740	26.72	302,764	24.24
2008	1,292,890	726,398	52.27	302,266	23.83	218,618	17.23
2009	1,373,009	634,382	47.04	344,635	25.56	315,738	23.41
2010	1,306,535	548,065	41.95	363,920	26.85	355,382	27.20
2011	1,508,965	608,866	40.40	474,664	31.50	421,412	27.90

Source: West African Examination Council 2002-2011

Table1 give the analysis of students' performance at the Senior Secondary School Certificate Examinations between 2002 and 2011 in Mathematics. A look at the table and the figure shows poor performance of students with grades A1-C6 recorded the highest of 52.27 in 2008 and failure grade F9 reached the peak of 34.74% in 2004. Though there were noticeable improvements from the year 2002 to 2008. But in 2009 to 2011, there were also noticeable decline in the performance of students with grades A1-C6 from 47.04% to 40.40% and the failure rate increased from 23.41% to 27.90% within these years. As a result, the situation in Nigeria is that, academic performance in Mathematics education is still in deplorable stage, both in primary and secondary Schools examinations. Many researchers identify inherent unfairness in school-based assessment (Grifith, 2005; Njabili, Abedi, Magesse, and Kalole, 2005; Asim, 2007) which may result from teachers' incompetency in assessment (Asim, Kalu, Idaka and Bassey, 2007), as well as psycho-cultural factors among others as being responsible for this anomaly (West African Examination Council, 2002).   Amoo (2002) reports that poor learning, interest and assimilation of Mathematics ideas, concepts, principles, processes and teacher's failure to use appropriate and stimulating teaching methods (Akinsola,1999;2000),are responsible for students' poor achievement in Mathematics in Nigeria. The teacher is the most important single determinant of what takes place in the classroom.

This is because, strategies of teaching Mathematics effectively in the classroom originates from the teacher (Akinsola & Olowojaiye, 2005; 2008). If the teacher is well prepared, well versed and thoroughly supported, then changes in the presentation of curriculum materials through innovative instructional strategies can occur (Akinsola & Popoola, 2004)..

These issues of students' poor performance in mathematics are brought about as a result of students' inactivity in the classroom which is characterized by the traditional method of teaching in our secondary schools (Akinsola & Ifamuyiwa, 2008). Thus, the strategies that will familiarize the students with the contents of instruction, empower them with sufficient level of mathematical proficiency, increase their interest and enhance their active participation in the subject and also efficacious in improving their interaction with the environment are highly needed. Tiered lesson, a learner-centered strategy which involves the teaching of students at various levels of difficulty as well as promoting higher level thinking skills among the students through tiering students into 2 – 3 per tier based on their ability levels, and Group personalization instructional strategy, which enables the students to relate the contents of the instruction to their life experiences by incorporating their biography, intelligences, sensibilities, favourite places, activities, sports, friends, convenience stores, foods, predominant work, recreation centres/amusement parks and competences into content of mathematics instruction were both employed for this study.

Tiered lesson is an instructional strategy that enables the teacher to teach students using Tiered instructional package, integrated under a single teacher inter face (Classroom Advantage, 2011). The tiered lesson used in this study is a two tier model instructional strategy where the teacher tiers the students into 2 – 3 per tier based on their mental ability test scores of low and high. The 2 tiers used in this study are homogenous in nature and each tier remains in their tier throughout the course of the study. At times we may have above average and below average (two tiers) or above average, average and below average (three tiers). A tiered lesson is described by Tomlinson (1999) as "the meat and potatoes of differentiated instruction." Ideally, tiered learning tasks engage students slightly beyond what they find easy or comfortable in order to provide genuine challenge and to promote their continued learning (Vygotsky, 1986). Optimally, a tiered task is neither too simple so that it leads to boredom nor too difficult so that it results in frustration. As Tomlinson (2001) cautioned, "Only when students work at appropriate challenge levels do they develop the essential habits of persistence, curiosity, and willingness to take intellectual risks".

Personalisation involves embedding students' past experiences and interests into the Mathematics content (Simsek and Cakir, 2009: Akinsola & Awofala, 2009). Personalisation is a method in which familiar people and

stories from their own past experiences are used to construct a bridge between new information and existing ones. Mathematics question constructed using personalisation, pulls out mathematics from abstract world and makes it practical and useful which students can use in their daily life. Moreover, students can learn easier with personalised instruction and keep mathematical content easier in their memory (Simsek and Cakir, 2009). There are three modes of personalization identified by Awofala, Balogun and Olagunju (2011). They are self referencing, individual and group. Self referencing according to d'Ailly and Simpson (1997) involves replacing the character names of standard mathematics problems with the word "You". According to Lopez and Sullivian (1992) individual personalization involves tailoring the domain context of instruction to individual rather than the whole class common interest and preferences. They also described group personalization as involving tailoring the domain context of instruction to dominant interest and preference of a group of students. Group personalization can be accomplished by incorporating personal information and preferences provided by students into their Mathematics problems. The teacher incorporates the biography, intelligences, sensibilities and competences (also emotional ones) of the student into the content of instruction. This enables the students to relate the content to their life experiences. In group personalization, the teacher takes the inventory of the common names of the students' favourite places, activities, sports, friends, convenience stores, foods, predominant work, recreation centres/amusement parks and so forth in the student's environment to build the content of instruction for the whole class.

Group Personalization aims to valorize all the potential of the learner. Group Personalised learning recognises the individual strengths, needs and goals of students and that schools respond to these differences and learning by tailoring the content of instruction to meet each student's needs in his/her locality. This strategy enhances the personalisation skill that will enable the student to relate mathematics to their immediate environment in their day to day activities. Group personalisation learning assists the development of the students' personal strengths and identifying areas of learning where students can be extended or accelerated (Commonwealth of Australia, 2011). By doing this, the teacher develops the skill of personalisation in individual student in the class.

Some learners' variables have the potential of influencing students' learning outcomes irrespective of the instructional strategy used (Akinsola, 2009). Among these variables which are used in this study are mathematics anxiety and gender.

Mathematics anxiety has become a focus to the researchers. This is because the Mathematics curriculum reform attaches much importance to the

emotional experience in the process of Mathematics learning. Mathematics anxiety is an emotional state of individuals in which people feel uneasy, apprehensive, or fear Mathematics. Mathematics anxiety is a feeling of intense frustration or helplessness about one's ability to do Mathematics (Yenilmez, Girginer, and Uzun, 2007). Bursal and Paznokas (2006) and Gresham (2004) described Mathematics anxiety as a lack of applied understanding and/or an irrational dread of Mathematics, often leading to avoidance of the subject. Zettle and Raines (2002) defined Mathematics anxiety as a state of discomfort that occurs in response to situations involving mathematical tasks that are perceived as threatening to self-esteem, and that can create a negative interest toward the subject. Mathematics anxiety can also be defined as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (Richardson and Suinn, 1972)**. Rubinsten and Tannock (**2010) defined anxiety as a negative reaction to Mathematics associated with negative emotions. It is a state of discomfort occurring in response to situations involving Mathematics tasks that are perceived as threatening to self-esteem. Mathematics anxiety is a kind of disease that is cognitively passive mood produced by Mathematics. This according to Luo, Wang, and Luo (2009) referred to such unhealthy mood responses which occur when some students come upon Mathematics problems and manifest themselves as being panicky and losing one's head, depressed and helpless, nervous, fearful, and so on. At the same time, it is accompanied by some physiological reactions, such as perspiration of the palms, holding tight the fists, being sick, vomiting, dry lips, and pale face. Students experience a feeling of self-threat in Mathematics learning, resulting in the loss of interest in Mathematics and the loss of confidence in Mathematics learning. They face much pressure in Mathematics learning, which, to some extent, leads to anxiety (Akinsola,2009). Parents with mathematics anxiety pass it along to their children, while teachers with mathematics anxiety pass it along to their students (Tella, 2009).

Both girls and boys have the same innate ability to learn mathematics skills and are born interested in a variety of objects and ideas (Spelke, 2005; Spelke and Grace, 2007). The poor Mathematics performance of students is further worsened by gender imbalance leading to the problem which now constitutes a major research focus across the globe (UNESCO, 2008). Opot-Okurot (2005): noted that for all the attitudinal variables (anxiety, confidence and motivation), males had higher mean scores than females. Therefore, bridging gender gap is one major way of achieving egalitarianism and enhancing human development.   Gender inequality in education has remained a perennial problem of global scope (Bordo, 2001; UNESCO, 2003; Reid, 2003). In Nigeria, Abiam and Odok (2006) found no significant

relationship between gender and achievement in number and numeration, algebraic processes and statistics. They however found the existence of a weak significant relationship in Geometry and Trigonometry. In school, it is believed that Mathematics is for the boys and this belief may further widen the gender gap in Mathematics achievement (Mutemeri and Mygweni, 2005). While exploring the gender differences in mathematics achievement, Campbell and Storo (1996) found that certain myths have become widely accepted as truths. One such myth is that "women are qualitative; men are quantitative". The result of this belief is that girls are much less apt than equally talented boys to go into mathematics related careers, including engineering and the physical sciences. The empowerment of women and elimination of gender inequality in Basic and Secondary Education by 2005 and at all levels by 2015 is one of the goals of Millennium Development Goals (MDGs).

Three practices that are regular parts of the traditional Mathematics classroom and which cause great anxiety in many students are imposed authority, public exposure and time deadlines (Curtain-Phillips, 2011). Therefore, teaching methods must be re-examined. Consequently, there should be more emphasis on teaching methods which include student directed class discussions (Akinsola, 2011). Given the fact that many students experience mathematics anxiety in the traditional classroom; teachers should design classroom activities that will make students feel more successful. Students must have a high level of success or a level of failure that they can tolerate. Therefore, incorrect responses must be handled in a positive way to encourage students' participation and enhance students' confidence. Studies have shown that students learn best when they are active rather than passive learners (Spikell, 1993). Everyone is capable of learning, but may learn in different ways. Therefore, lessons must be presented in a variety of ways. For example, different ways to teach a new concept can be through group personalisation, tiered lesson, where the students will have sense of belonging. Lesson tiered or personalised may enhance students' performance which is the focus of this study because learners of today are different from what they were forty years ago. Learners today ask questions why something is done this way or that way and why not this way. Whereas years ago learners did not question the why of Mathematics concepts; they simply memorized and mechanically performed the operations needed. It is against this background that this study looked into the effects of Tiered-lesson and group personalisation instructional strategies on senior secondary school students' achievement in Mathematics.

Statement of the Problem

This study investigated the Effects of Tiered Lesson and Group Personalisation Instructional Strategies on Senior Secondary School Students' Achievement in Mathematics. The study also examined the moderating effects of Mathematics Anxiety and gender on the dependent measure.

Hypotheses:

This study tested the following null hypotheses at 0.05 significant levels.

Ho_1:   There is no significant main effect of treatment (tiered lesson, group personalisation and conventional method) on students' Achievement in Mathematics.

Ho_2:   There is no significant main effect of Mathematics anxiety on students' Achievement in Mathematics.

Ho_3:   There is no significant main effect of gender on students' Achievement in Mathematics.

Ho_4:   There is no significant interaction effect of treatment, Mathematics anxiety and gender on students' Achievement in Mathematics.

Research Method
Design

This study adopted the pretest, posttest control group quasi-experimental design involving a 3 x 3 x 2 factorial matrix. Learning strategies (Conventional Method, Tiered Lesson and Group Personalisation Instructional Strategies) were crossed with mathematics anxiety (low, medium and high) and gender (male and female).

Participants

The participants for this study comprised all the Senior Secondary School Two students (SSS II) drawn from Secondary Schools in Epe, Ibeju and Ikorodu in Lagos State. The choice of SSS II students was considered more appropriate because these students would have been exposed to some basic Mathematics concepts and skills which would enable them to solve algebraic problems. Besides, students had enough time for the experiments since they were not preparing for any external examination. In addition, these students were willing and free to express their opinions and interest in Mathematics. Three out of 20 Local Educational District *(LEDs)* in Lagos Sate were used. A total of 337 students *(206 male and 131 female)* were used. The subjects were subjected to varied academic ability levels. The selected groups in each LED were assigned randomly to a treatment group so as to avoid interaction that may occur among the groups if two or more

treatment groups were located in the same school. To avoid disrupting the schools' programme or arrangements, intact classes were used.

Instruments

Four research instruments were used in this study. These are: (i) Mathematics Achievement Test (MAT), (ii) Mathematics Anxiety Questionnaire (MAQ), Numerical Ability Test (NABT) and Personal Interest Inventory (PII).

Mathematics Achievement Test (MAT)

The MAT is a 40-item multiple choice Mathematics achievement test with four options per item. The MAT was constructed and validated by the researchers to measure students' academic achievement in Mathematics based on the school curriculum for the term. To test the instrument, the 40-item MAT was administered on a sample of 80 SSS year two students (40 males and 40 females) in two schools that were not part of the study, but whose students are similar in age and class to the students involved in the study. From the students' responses, a reliability coefficient of 0.79, using the Kuder-Richardson method, was obtained.

Mathematics Anxiety Questionnaire (MAQ)

MAQ was made up of two sections, that is, section A and section B. Section A consisted of questions that sought background information about students' life, school, Gender and Age and Section B consisted of 27 items to determine the level of student's anxiety. Students' method of response to the items was the closed response mode of 5 point likert scale modified to 4 point scale of strongly agree (SA), agree (A), disagree (D) and strongly disagree (SD). This instrument was adopted from 98-item Mathematical Anxiety Rating Scale (MARS) developed by Richardson and Suinn in 1972. It has been considered by Zettle and Raines (2002) to be valid and reliable instrument for testing students' anxiety level. The instrument was given to 80 students that were not part of the study and the reliability coefficient using Cronbach Alpha Reliability Method was found to be 0.89.

Numerical Ability Test (NABT)

This test has been validated for use in Nigerian secondary schools and has since been used for many higher degree research works (Abimbade 1987; Bekee, 1987). The scores of the students in NABT which measured numerical ability of students represented the students' ability. Thus tiering the students into high and low ability levels was based on the scores of the NABT. This was done by ranking the sum of the scores from the highest to the lowest and used to categorize them into two tier levels. Those within the upper 50% were considered as high ability and the bottom 50% were considered low ability. The instrument was given to 80 students that were

not part of the study and the reliability coefficient using Kuder Richardson Method (Formula 20) indicated a reliability coefficient of 0.89 for NABT.

Personal Interest Inventory (PII)

This is a 19-item questionnaire used to determine the personal backgrounds and interests of the participants. This includes the names of the students' favourite places, activities, sports, friends, convenience stores, foods, and so forth. Students gave two favourite responses for each survey item. The questionnaire was face validated in terms of language clarity to the target audience *Teacher's Instructional Guide (TIG)*

The TIG is an operational guide that was used by the trained teachers in the experimental and control groups to ensure uniformity. The TIG consists of the activities, behaviours and specific instructions guiding the teachers supervising and instructing the experimental and control groups respectively. The TIG was used in training the six SSS II Mathematics teachers that participated in the study (before the commencement of treatment).

Learning Packages

Two learning packages developed and validated by the researchers were used as intervention in the experimental groups.

Tiered Lesson Instructional Package (TLIP)

This is a text-assisted programmed instructions designed and validated by the researchers covering five broad topics in Mathematics. It was the treatment (stimulus instrument) that was used by the first experimental group (Tiered-Lesson Instructional Strategy, E_1). It contained 25 lessons covering five weeks of five periods per week as contained in the scheme of work for SSS II classes in Mathematics. The broad topics covered were: approximations and percentage error, ratio, proportions and rates, percentages, sequence and series, concept of sequence and series, terms of A.P and sum, solving problems on A.P., terms of G.P. and sum, problem solving on G.P, Geometric mean, simultaneous equations; one linear and one quadratic solution by substitution method, solving more problems on the topic, word problems on simultaneous equation. The TLIP was trial-tested on a group of 80 SSS II students having characteristics similar to the intended students for the main study. The feedback obtained from the learners, as it concerned the length and timing of the lessons, the simplicity or otherwise of the examples and solutions provided as well as the workability of the package for the study, was used to further modify the TLIP in order to make it useful and suitable for the main study.

Group Personalisation Instructional Package (GPIP)

The GPIP is similar to the TLIP in content and model. It was also a developed and validated programmed instruction designed by the researchers

to develop the students' skill in personalisation. It was the treatment (stimulus instrument) that was used by the second experimental group (Group Personalisation Instructional Strategy, E_2). The GPIP was a programme of teach yourself the skill of personalisation. Before the development of the GPIP, 19-item student personal interest inventory (PII) was used to determine the personal backgrounds and interests of the participants. Topics included the names of the students' favourite places, activities, sports, friends, convenience stores, foods, and so forth. Students gave two favourite responses for each item. The PII was administered one week prior to the pretest. Responses to each PII item were tabulated by the experimenters and then used to design the personalised version of the instructional programme. The stimulus part of the GPIP was prepared in groups, week by week, while the response part was produced separately. Each student received first the response part after each lesson in other to solve the relevant exercises in group, in line with the instructions in the package. This ensured that the 'student learning' personalisation model chosen for the study was properly utilized during the treatment and data collection period. The GPIP was also trial-tested on a different group of SSS II students having characteristics similar to that of the intended subjects for the main study. It was also administered on 80 SSS II students. This was done in order to find out its suitability for the main study. The feedback obtained from the learners, especially as it concerned the workability of the package for learner, was used to further modify the GPIP in order to make it useful and suitable for the main study.

Data Collection Procedure

        The research procedure was divided into three phases: (a) pre-intervention phase (b) intervention phase and (c) post-intervention phase.
(a)   Pre-Intervention Phase
        The actual pre-intervention phase followed the steps below:
        The researchers, as the resource persons, trained the six participating teachers and two research assistants for two weeks. With the TIG, the participating teachers were trained on the use of the learning packages (TILP and GPIP), how to create the right type of environment for the experimental and control groups and how to administer the other instruments (MAT and MAQ). The participating teachers used the third week for trial testing. This was done to ensure that the teachers mastered the intervention for the experimental and control groups and applied it throughout the intervention period. The two research assistants were asked to rate the participating teachers (using the intervention rating scale prepared by the researchers) during the trial practice. The exercise produced inter-rater reliability values of between 0.77 and 0.81 range.

(b)   *Intervention Phase*

The fourth week was used for pretest. The researchers with the help of the research assistants and the trained teachers administered the pretest to the participating students in the following order: Mathematics Anxiety Questionnaire (MAQ) before the Mathematics Achievement Test (MAT). The intervention period took five weeks in each of the six schools. This involved the use of the TLIP for the students in the experimental group 1, the use of the GPIP for those in the experimental group 2 and the use of the conventional method of teaching for the students in the control group. During the intervention period, no interaction was allowed between the students in the intervention and control groups, whose schools were located in different areas.

(c)   *Post-Intervention Phase*

The eleventh week was used for posttest which comprised the administration of the Mathematics Achievement Test (MAT) in both the experimental and control groups.

Data Analysis Procedure

The hypotheses raised in the study were tested inferentially using the Analysis of Covariance (ANCOVA) statistics. The use of ANCOVA was to control for the differences between groups as revealed in the pre-test. The multiple Classification Analysis (MCA) and the Scheffe post-hoc analysis were used to explain the magnitude of the post test achievement scores of the different categories of students, and to explain the direction of possible significant effects respectively.

Results and Discussion

The sequence of the presentation and discussion of the results obtained in the study is in accordance with the hypotheses formulated for the study.

Hypothesis 1:

There is no significant main effect of treatment (tiered lesson, group personalisation and conventional method) on students' Achievement in Mathematics.

Table 1 reveals the main effect of treatment on students' achievement in Mathematics. The result showed that there is significant main effect of treatment on students' achievement in Mathematics ($F_{(2, 318)}$ = 324.734, $P <$ 0.05). The result implied that the achievement scores of the students exposed to different treatment conditions are significantly different. Therefore, the null hypothesis [1] is rejected.

Table 1: Summary of Analysis of Covariance of Students' Achievement According to
Treatment, Mathematics Anxiety and Gender
*Denote significance at P<0.05

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	13767.141	18	764.841	156.942	.000
Pretest	34.519	1	34.519	7.083	.008
Main Effect:					
Treatment	3165.126	2	1582.563	324.734	.000*
Mathematics Anxiety	1194.326	2	597.163	122.535	.000*
Gender	4.585	1	4.585	.941	.333
2-way Interactions:					
Treatment x Maths Anxiety	377.887	4	94.472	19.385	.000*
Treatment x Gender	6.484	2	3.242	.665	.515
Maths Anxiety x Gender	29.747	2	14.873	3.052	.049*
3-way Interactions:					
Treatment x Maths Anxiety x Gender	50.734	4	12.684	2.603	.036*
Error	1549.744	318	4.873		
Total	**15316.884**	**336**			

In order to determine the magnitude of the mean achievement scores of students exposed to the different treatment conditions, the result of the Multiple Classification Analysis (MCA) presented in Table 2 was used.

Table 2: Multiple Classification Analysis of Students' Achievement According to
Treatment, Mathematics Anxiety and Gender.

Grand Mean = 28.27					
Variable + Category	N	Unadjusted variation	Eta	Adjusted for independent + covariates deviation	Beta
Treatment Group:					
1. Tiered lesson	147	4.25		4.02	
2.Group Personalisation	90	2.28		.96	
3. Control	100	-8.30	.81	-6.77	.68
Mathematics Anxiety:					
1. Low	122	5.89		4.08	
2. Medium	102	-.29		-2.69	
3. High	113	-6.10	.74	-1.98	.46
Gender:					
1. Male	206	2.69		.29	
2. Female	131	-4.23	.50	-.46	.05
Multiple R-squared					**.859**
Multiple R					**.927**

The result reveals that, with a grand mean of 28.27, the students exposed to tiered lesson package (use of tiered lesson instructional strategy) had the highest adjusted post test mean achievement score of 32.29 (28.27 + 4.02). The students exposed to the group personalisation package (use of

group personalisation instructional strategy) had the next higher adjusted post test mean achievement score of 29.23 (28.27 + 0.96) while the students in the control group (use of conventional teaching method) obtained the least post test mean achievement score of 21.50 (28.27 – 6.77). This result showed that the tiered lesson instructional strategy had the greatest potency at effecting student's achievement in Mathematics. The result in Table 2 further reveals that while treatment alone accounted for 46% $(0.68)^2$ of the variation in students' achievement in Mathematics, the independent and moderator variables jointly accounted for 86% $(0.927)^2$ of the variance observed in the students' achievement scores in mathematics.

In probing further into the source of the significant difference recorded in Table 1 the Scheffe post-hoc analysis presented below was carried out.

Table 3: Scheffe Post-Hoc Pairwise significant differences among the various Mathematics Anxiety groups on the Students Achievement in Mathematics

Treatment Group	Treatment Groups	(J) Treatment groups	Sig
Post Student Achievement in Mathematics	Low	Medium High	.001 .000
	Medium	Low High	.001 .000
	High	Low Medium	.000 .000

It is shown in Table 3 that there were pair significant differences between the Low group and Medium group, Low group and High group and between Medium group and the High group.

The findings of this study revealed that there was significant effect of treatment on students' achievement in mathematics. The result showed that tiered lesson instructional strategy was more effective at improving students' performance in mathematics, followed by group personalisation instructional strategy and the conventional method of teaching was the least effective. The effectiveness of tiered lesson instructional strategy over both group personalisation instructional strategy and conventional teaching method may be due to the fact that tiered lesson instructional strategy is a learner-centered. Students were put into tiers in which a tier leader coordinated the learning as a result of this increase the interactions of the students. This finding is in agreement with the findings carried out by Adams (2010), Bryant (2008), Adam and Pierce (2004) and Tomlinson (2001).

In the case of group personalisation instructional strategy, the superiority exhibited over the conventional method of teaching may be due to the fact that the students' biography, intelligences, sensibilities, favourite places, activities, sports, friends, convenience stores, foods, predominant work, recreation centres/amusement parks and competences are incorporated

into the content of instruction. This enables the students to relate the content to their life experiences. This finding is in agreement with the submissions of Awofala, Balogun and Olagunju (2011), Bates and Wiest (2004), Renninger, Ewen, and Lasher (2002), Ku and Sullivan (2002), d"Ailly and Simpson (1997), Ensign (1997), Hart (1996), Cordova (1993), Lopez and Sullivian (1992), Davis-Dorsey, Ross and Morrison (1991), Spiro and Jehng (1990), Salomon and Perkins (1989), Ross, McCormick and Krisak (1985).

The interaction effects were supported by graphical illustrations below.
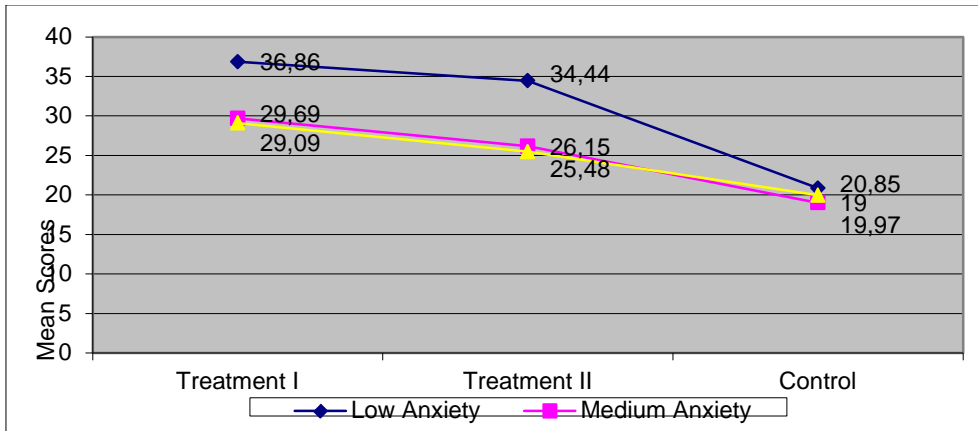
Fig 1: Interaction Effect of Treatment and Mathematics Anxiety on Achievement in Mathematics
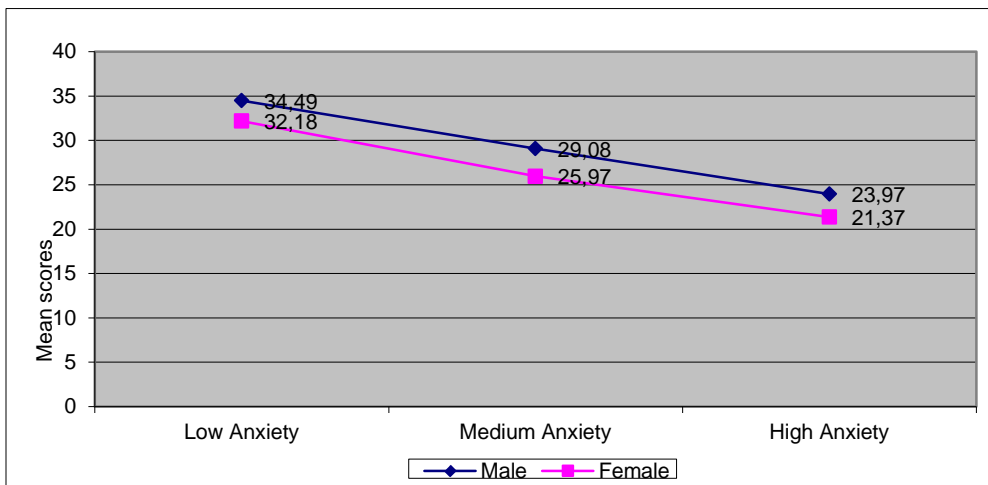

Fig 2: Interaction Effect of Mathematics Anxiety and Gender on Achievement in Mathematics
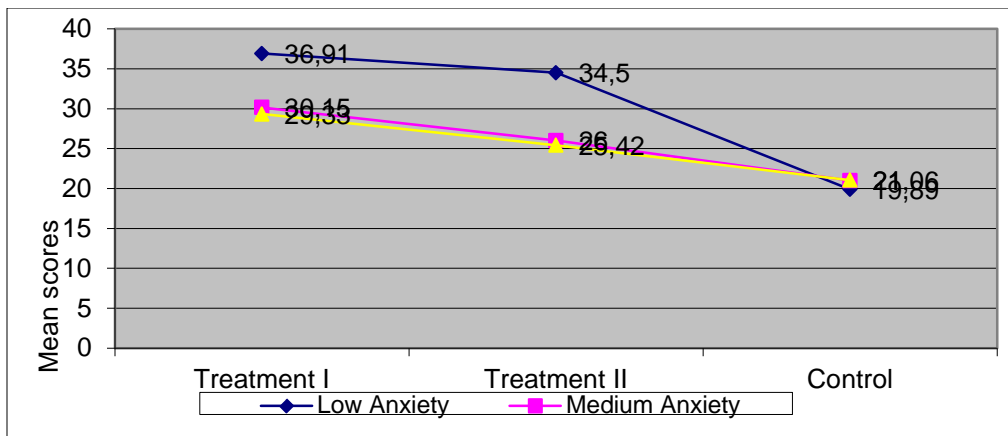
Fig 3: Interaction Effect of Treatment and Mathematics Anxiety by Males on Achievement in Mathematics
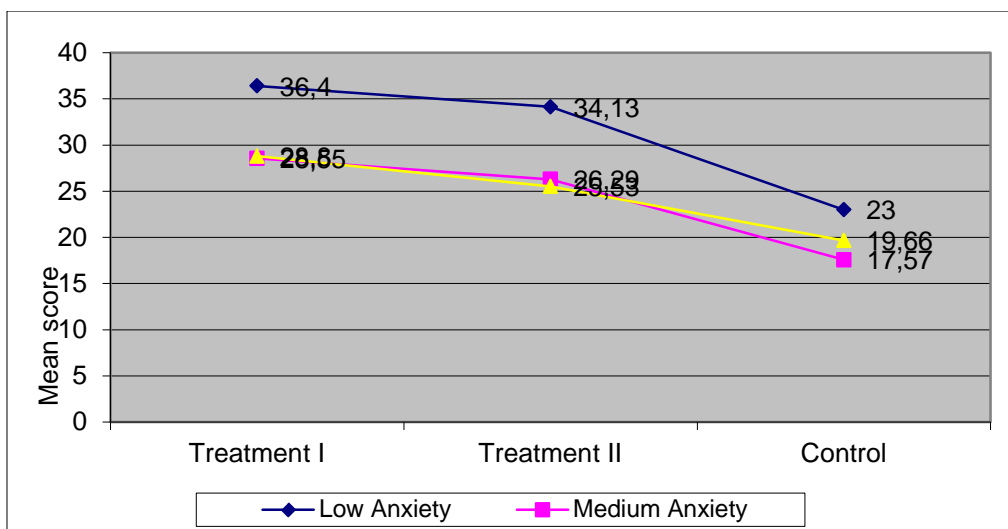

Fig 4: Interaction Effect of Treatment and Mathematics Anxiety by Females on Achievement in Mathematics

Hypothesis 2:

There is no significant main effect of Mathematics Anxiety (Low Anxiety, Medium Anxiety and High Anxiety) on Students' Achievement in Mathematics.

The result of the main effect of mathematics anxiety in Table 1 reveals a significant difference between low, medium and high mathematics anxiety on students' achievement in mathematics ($F_{(3,333)} = 122.535$, P<.05). This means result showed that the post mean achievement scores of the students having low, medium and high mathematics anxiety were significantly different from one another. Hence, the hypothesis [2] is

rejected. However, the result of MCA in Table 2 further reveals that the low mathematics anxiety students ranked first in the post achievement with adjusted mean score of 34.16, next to medium mathematics anxiety students who recorded adjusted post achievement mean score of 27.98 while the high mathematics anxiety students recorded an adjusted post achievement mean score of 22.17 was ranked least. However, this difference was statistically significant. The result in Table 2 further reveals that mathematics anxiety alone accounted for 21% $(0.46)^2$ [greater than 10%] of the variance observed in the students achievement scores in mathematics.

The study showed that the low mathematics anxiety students had the highest post adjusted achievement mean score in mathematics, followed by those with medium mathematics anxiety students while the high mathematics anxiety students had the lowest adjusted achievement mean score. These findings are in agreement with the submissions of Luo, Wang and Luo (2009), OECD (2004).

Hypothesis 3:
There is no significant main effect of Gender (Male and Female) on Students' Achievement in Mathematics.

The result from Table 1 shows that there was no significant difference in Gender (Male and Female) on Students' Achievement in Mathematics ($F_{(2,334)} = 0.941$, P >.05). This implied that the male and female students who participated in the study were not significantly different in their achievement in mathematics. Hence, the null hypothesis [3] is not rejected. However, the result of the MCA in Table 2 reveals that male students who participated in the study recorded better adjusted post achievement mean score of 30.96 than the females who recorded adjusted post achievement mean score of 24.04. The observed difference is not however statistically significant. The result in Table 2 further reveals that gender alone accounted for just 0.25% $(0.05)^2$ [less than 1%] of the variance observed in the students' achievement in mathematics scores.

The non-significant main effect of gender on students' achievement in this study conforms to the findings of Yenilmez, Girginer and Uzun (2007) and Abiam and Odok (2006) but at variance with the findings of UNESCO (2008) and Opot-Okurot (2005).

Hypothesis 4:
There is no significant interaction effect of Treatment, Mathematics Anxiety and Gender on Students' Achievement in Mathematics.

The result of the 3-way interaction effects in Table 1 reveals a significant interaction effect of treatment, mathematics anxiety and gender on students' achievement in mathematics. ($F_{(18,318)} = 2.603$, P< .05). This

result implied that there is significant difference in students' group-achievement in mathematics (based on treatment) among all the possible mathematics anxiety – gender combinations: low-boys, low-girls, medium-boys, medium-girls, high-boys and high-girls. Hence, the null hypothesis [4] is rejected. The result in Table 2 further reveals that while treatment alone accounted for 46% $(0.68)^2$ of the variation in students' achievement in Mathematics, the independent and moderator variables jointly accounted for 86% $(0.927)^2$ of the variance observed in the students' achievement scores in mathematics.

Conclusion

This study determined the effects of Tiered Lesson and Group Personalization instructional strategies on Senior Secondary School Students' Achievement in Mathematics. The study is an extension in the use of learning packages that emphasize the active participation and intellectual involvement of learners. The interactive effects of treatment, Mathematics anxiety and gender on the students' achievement in Mathematics were also determined. The result of the study revealed that Tiered lesson and Group personalization instructional strategies through the use of learning packages are effective methods of learning Mathematics. The conventional teaching method of Mathematics was found to be the weakest of the three strategies in improving students' Achievement in Mathematics. The Tiered instructional strategy through the use of Tiered instructional learning package was found to be more effective in promoting students' Achievement in Mathematics than the Group personalization instructional strategy. The Group personalization instructional strategy, through the use of Group personalization package was found to be more effective in improving students' Achievement in Mathematics than the conventional method.

Recommendations

- The study therefore recommends the use of Tiered lesson and Group personalization instructional strategies involving the use of learning packages for teaching and learning of secondary school Mathematics.
- It is further recommended that Mathematics teachers should shift from the use of conventional method of teaching and embrace the use of a combination of Tiered lesson and Group personalization instructional strategies. The teachers need to be trained to develop their skills in the preparation and development of learning packages and how to use the packages to assist their students in learning Mathematics so that learners will develop a positive interest in Mathematics. Also, teachers must not discriminate among students whether Mathematical anxiety is high, low or medium when the students use the learning packages.

- The curriculum planners should design a course that will be specially made for designing packages in all our teacher training tertiary institutions in Nigeria. The textbooks should be written in form of learning packages to lessen the teacher's burden in our secondary schools.

- Moreover, appropriate courses should be introduced into teacher education programmes for training teachers in the skill of designing useful learning packages, while school administrators at the secondary school level should provide the needed facilities and encourage Mathematics teachers toward the development of useable and valid learning packages.

It is also recommended that mathematics teachers embrace Tiered lesson and Group personalization instructional strategies that are capable of making the teaching and learning of mathematics more practical and relevant to everyday life irrespective of the gender and mathematical anxiety of the

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