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Improving Students' Interest in Mathematics through Tiered Lesson and Group Personalisation Instructional Strategies

Mojeed Kolawole Akinsola
Professor, Mathematics Education, Department of Teacher Education,
Faculty of Education, University of Ibadan, Ibadan, Nigeria
Fisayo Areelu
Chief Lecturer, Department of Mathematics, School of Sciences,
Michael Otedola College of Primary Education, Noforija, Epe, Lagos State, Nigeria

Abstract:
This study examined Tiered Lesson Instructional Strategy (TLIS) and Group Personalization Instructional Strategy (GPIS) as determinants of Students' Interest in Mathematics. 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 from three local educational district areas in Lagos State participated in the study. Three instruments were developed, validated and used for the data collection. Four null hypotheses were tested at 0.05 significance level. Data were analysed using Analysis of Covariance and Scheffe Post hoc test. The findings revealed that treatment had significant effect on students' interest in Mathematics ($F_{(3,333)} = 43.146, P<.05$). Students exposed to TLIS had the highest post interest score. The study also showed a significant effect of Mathematics Anxiety (MA) on interest in Mathematics ($F_{(3,333)}=5.362, P<.05$). Students with Medium MA had the highest post interest score. It was also revealed that gender had no significant effect on students' interest in Mathematics. TLIS and GPIS both aroused students' interest in Mathematics. TLIS has helped students with MA to learn effectively as their counterparts without MA. It was therefore concluded that TLIS and GPIS should be adopted for the teaching of Mathematics. Mathematics teachers should also be trained to use these packages in classroom since they have been found to be effective in improving the students' interest in Mathematics.

Keywords: *Tiered lesson instruction, group personalization instruction, students' interest in mathematics, mathematics anxiety, gender*

1. Introduction

Interest in Mathematics guides our behaviours in making choices. The desire to re-engage in content over time, to seek answers to questions, to acquire more knowledge and to promote achievement and excellence in education as well as professional careers. Interest in Mathematics is an important force determining the quality of learning as well as educational and occupational choices (Frenzel, Goetz, Pekrun and Watt, 2010). The lack of academic interest in Mathematics among many students is a major problem for educators (Hidi and Harackiewicz, 2000). The science and Mathematics in particular seem to repel many students during adolescence (Kessels and Hannover, 2007). Research has repeatedly shown downward developmental trends of Mathematics interest during the course of secondary school (Akinsola, 2002; Fredricks and Eccles, 2002; Ko¨ller, Baumert, and Schnabel, 2001Watt, 2004 ;). Interest in Mathematics is an important variable in learning Mathematics because when one becomes interested in an activity, one is likely to be more deeply involved in that activity (Okigbo and Okeke, 2011). Interest is therefore conceived by Beier and Rittmayer (2008) as a determinant of the valence components of expectancy-value models and can be shaped by ones' attitudes towards an idea or a course (Ifamuyiwa & Akinsola, 2008). Interest is a motivational variable that is linked with educational attainment in that students are more likely to engage in an academic activity, pay more attention, and generate higher performances if they are interested in the topic (Schunk, Pintrich and Meece, 2008). Schiefele (1991) sees it as a content-specific motivational characteristic composed of intrinsic feeling-related and value-related valences. It describes the cognitive and affective relationship between a student and particular classes of subject matter. Interest can hold a student's attention, encourage effort, and support learning. It also has been found to enhance strategic processing. Imoko and Agwagah (2006) described interest as a subjective feeling of concentration or persisting tendency to pay attention and enjoy some activity or content. The relationship between interest and learning has focused on three types of interest: individual, situational, and topic. Individual interest is considered to be an individual's predisposition to attend to certain stimuli, events, and objects. Situational interest is elicited by certain aspects of the environment. These include content features such as human activity or life themes, and structural features such as the ways in which tasks are organized and presented. The Topic interest is triggered when a specific topic is presented this seems to have both individual and situational aspects (Ainley, Hidi and Berndorff, 2002).

Interest has both trait and state properties. At the trait level individual can value an object, so much so that it becomes identified with the self (Carmichael, Callingham, Hay and Watson, 2010). Having such interest is considered to be essential for psychological health (Hunter and Csikszentmihalyi, 2003). At the state level, situational interest is identified as one of several basic human emotions and is considered to be similar to the motivational state of curiosity (Silvia, 2001). Interest in a content area is correlated with many positive factors in education that lead to increased academic performance (Schunk, Pintrich and Meece, 2008). Research conducted by Beier and Rittmayer (2008); Marsh, Trautwein, Lüdtke, Köller, and Baumert, (2004) showed that gender differences in interest and self-concept significantly affect the choice to pursue Science, Technology, Engineering and Mathematics (STEM) related studies and careers, as well as performance in STEM. The low interest in Mathematics emanates from Mathematics anxiety and fear (Okigbo and Okeke, 2011). Mathematics anxiety has been observed by Okigbo and Okeke (2011) to be an academic sickness whose virus has not yet been fully diagnosed for an effective treatment in the class and the symptoms of this phobia are usually expressed on the faces of Mathematics students in their classes. The West African Examination Council (WAEC) Chief Examiner's Report (2009) suggested that teachers should help students improve their achievement and develop interest in Mathematics by reducing the abstractness of Mathematics, and remove their apathy and fears of the subject (Akinsola, 2009)..

These issues of students' low interest in mathematics are brought about as a result of students' inactivity in the classroom which are characterised by the traditional method of teaching in our secondary schools (Akinsola & Olowojaiye, 2008; Akinsola & Ifamuyiwa, 2008). Thus, the strategies that will familiarize the students with the contents of instruction, increase their interest, empower them with sufficient level of mathematical proficiency and enhance their active participation in the subject and also efficacious in improving their interaction with the environment are highly needed. Therefore, Tiered lesson and group personalisation instructional strategies that are capable of enhancing student's interest are both employed for this study.

Tiered lesson is an instructional strategy that can be used to differentiate instruction in classroom **(**Adams and Pierce, 2004)**.** A tiered lesson has the same learning objective(s) for all students **-** the learning objective is determined through state content standards or indicators. The lesson becomes differentiated through the tiers, which are different learning activities for several various groups of students. There are three main ways to tier instruction: readiness, interest, or learning styles. The overall goals and the students' needs will determine the most appropriate approach. (Buckner, 2009). Tomlinson (1999) described tiered lessons as "the meat and potatoes of differentiated instruction." A tiered lesson is a differentiation strategy that addresses a particular standard, key concept, and generalization, but allows several pathways for students to arrive at an understanding of these components based on their interests, readiness, or learning profiles. A lesson tiered by readiness level implies that the teacher has a good understanding of the students' ability levels with respect to the lesson and has designed the tiers to meet those needs. Many examples of lessons tiered in readiness have three tiers: below average level, average level, and above average level. There is no rule that states there may only be three tiers, however. The number of tiers we use will depend on the range of ability levels in the classroom. Hence, the idea of flexible, rather than static, groups is essential. (Adam, 2010). Even when students are already homogeneously grouped in classes by ability, there is still variance in their ability levels that must be addressed. (Adam, 2010). Tiered lesson is important because students arrived with varied Cultural and linguistic backgrounds, Learning opportunities and experiences, the Interests are not uniform and different Readiness levels (Tag, 2009). Lessons Activities, Homework Learning Center, Assessments, Materials Assignments, Writing Prompts Strategies and Learning Contracts are some of the activities that can be tiered.

Tiered lesson instruction is an instructional strategy that recognizes and supports individual differences in learning. It involves matching students' approach to learning with the most appropriate pedagogy, curriculum goals and opportunities for displaying knowledge gained (Anderson, 2007; Ellis, Gable, Gregg, & Rock, 2008). Tiered lesson instruction maximizes learning by considering students' individual and cultural learning styles, recognizing that some students will require adjusted expectations, and offering different ways for students to explore curriculum and demonstrate learning (as well as accepting that these different methods are of equal value). With Tiered lesson instruction, the teacher aims to create learning situations that match students' current abilities and preferred learning styles while stretching their abilities and encouraging them to try new ways of learning. (Knowledge and Employability Studio, 2005). This approach uses students' capacity to benefit from the instruction provided to infer their approach to learning and to differentiate subsequent teaching to take account of this (Vellutino, Scanlon, Small, & Fanuele, 2006). Tomlinson and Strickland (2005), for example, noted that teachers usually differentiate the teaching by modifying one or more of the following: what students learn (the content), how they will learn it (the process), and how they will show what they have learnt (the product). To do this, educators (e.g., Anderson, 2007; Rock, Gregg, Ellis and Gable, 2008; Tomlinson, 2000) recommend that teachers give consideration to the knowledge, interests and abilities students bring to a learning context, the key or essential ideas and skills of the content area, how the students will be grouped or organised for learning (flexible grouping according to common interests, topic or ability) and the important features of the assessment procedures used (these features often include ongoing and meaningful assessments that are integrated with the teaching). As well, teachers and schools are encouraged to evaluate regularly the differentiated provision and make necessary modifications to the content, process and products. Teachers can tier their teaching more effectively when they: (1) understand how these students learn and think; (2) know a range of teaching options for differentiating their teaching; (3) can apply the differentiated teaching to topics in their classroom; (4) have the appropriate motivation orientation; and (5) can read the culture and climate in their school and classroom in terms of this tiering (Munro, 2010; 2011; 2012).

Personalisation involves embedding students' past experiences and interests into the Mathematics content (Simsek and Cakir, 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 (Akinsola & Awofala, 2009). 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). Personalization has been defined as putting the person's individual needs in the center of his/her life and building his/her life on this base [Diack, 2004]. Personalized instruction assists students by adapting personal choices and interests in the learning context [Chen and Liu, 2007]. Personalizing mathematics involves incorporating selected information with students' personal preferences and interests into the problem context [Bates and Wiest, 2004], [Van Eck and Dempey, 2002], [Ku and Sullivan, 2000, Ku and Sullivan, 2002]. Many studies on personalization assessed student learning outcomes using paper-based personalized mathematics instruction [Bates and Wiest, 2004, Ku and Sullivan, 2002]. In fact paper-based group personalization (tailoring problems to whole-class rather than individual content) was easy to construct and needed no computer system was however used in this study.

Group personalisation instruction is one way to individualize instruction that may be important for Mathematics learning (Ensign, 1997). Students "don't care how many apples Taiwo gave to Kehinde. They're much more interested in things like music, video games, movies, trading cards, money, and friends" (Bailey, 2002, p. 61). Giordano (1990) added, "student fascination with problems can be enhanced when names, locations, and events are changed to personal referents" (p. 25). However, in practice, classroom Mathematics rarely links to students' life experiences. By setting up this system, the children are not only limited to the classroom setting, but they are more alert of their surroundings. Students today have a need for practical Mathematics. Therefore, Mathematics needs to be relevant to their everyday lives. To learn Mathematics, students must be engaged in exploring, conjecturing, and thinking rather than engage only in rote learning of rules and procedures (Curtain-Phillips, 2011). This method leads them to learn about self-correction, self-instruction, and self-motivation because of its "hand on experience" approach. The idea of group personalisation is not new to education, but originates in business. In the 1980s in America, academics, Charles Sable and Michael Piore wrote *The Second Industrial Divide*, which argued that the era of mass production would be superseded in advanced economies by the age of 'flexible specialization'. The radical idea that products previously produced for a mass market would be turned to personal need, trickled-down as an idea into social norms and public services. Group Personalised learning's manifestation in education is the demand for high standards suited to individual need, and more choice in the way our students learn; it is shaping teaching around the different ways in which children learn.

Some learners' variables have the potential of influencing students' interest irrespective of the instructional strategy used and two of these variables used in this study are mathematics anxiety and gender.

Mathematics anxiety is physiologically exhibited by sweaty palms, nausea, heart palpitations and difficulty in breathing (Malinski, Ross, Pannells and McJunkin, 2006; Perry, 2004). It interferes with the manipulation of numbers and the solving of mathematical problems in academic, private, and social environments (Richardson and Suinn, 1972; Suinn, Taylor and Edwards, 1988). All of these definitions of Mathematics anxiety suggest that it may result in fear, distress, shame, inability to cope, sweaty palms, nervous stomach, difficulty in breathing, and a loss of ability to concentrate (Bursal and Paznokas, 2006). The psychological indicators of Mathematics anxiety include feelings of tension (Richardson and Suinn, 1972), fear and apprehension (D'Ailly and Bergering, 1992), low self confidence, a negative mindset towards Mathematics learning (Jain and Dowson, 2009), feeling threatened (Zohar, 1998), failing to reach potential (Perry, 2004) and a temporary reduction in working memory (Ashcraft and Kirk, 2001).

Mathematics anxiety affects a notable proportion of the school age population Ashcraft and Ridley (2005), Chinn (2009), Khatoon and Mahmood (2010). This can have large-scale implications. For example, only 7% of pupils in the UK take mathematics to A level, and while there are many reasons for this, many pupils give a dislike of mathematics as a reason for not continuing [Brown and Brown, Bibby (2010)] and sometimes the dislike is very intense and 'charged with emotion' [ibid, p. 10]. Studies have shown moderate correlations between Test Anxiety (TA) and MA (between .30 and .50), so they are indeed related constructs; however, measures of MA correlate more highly with one another (between .50 to .80) than with TA, which suggests that MA is a distinct construct [Ashcraft and Ridley (2005). Of all of the negative effects that MA has on learning and using mathematics, the relationship between MA and mathematics performance has received the most attention. Past research has shown small negative correlations between mathematics performance and MA (average correlations of -.27. and -.34 in two meta-analyses) [Khatoon and Mahmood (2010), Miller and Bichsel(2004)], indicating that those with high MA show poorer mathematics achievement. However, it has been argued that mathematics achievement, when measured in test situations, is always confounded with MA [Ashcraft and Ridley (2005). However, there are also many studies that show no gender differences in MA [Chinn (2009), Birgin, Baloğlu, Çatlıoğlu and Gürbüz (2010). However, in a more recent investigation, Birgin and colleagues found that the highest unique contribution to children's MA was from the children's mathematics performance Birgin, Baloğlu, Çatlıoğlu and Gürbüz (2010).

The first major issue that needs to be explored is teachers' beliefs about gender differences, specifically in mathematics ability. Teachers, sometimes attribute students' success and failure in mathematics to ability or effort, depending on the gender of the student. A second one that needs to be examined is the difference in the amount of attention and types of attention teachers give to female students as compared to that of the male student in the classroom. ((Kyei, Apam and Nokoe, 2011). However, mathematics- and science-related careers continue to be dominated by male. The difference in mathematical success between male and female lies not within abilities, but within attitudes and expectations of success (Kyei, Apam and Nokoe, 2011). Obviously, this maladaptive societal attitude renders numerous problems, but perhaps most detrimental of all is the fact that females are not realizing their full potential, thus limiting them not only in the classroom, but also in future career choices. Another myth is the linkage of a mathematics-gene in male. Parents and teachers alike hold lower expectations for females in mathematics and science than they do for males. In addition to these myths, most models of orientation to mathematics emphasize on social factors such as gender stereotypes. It is these gender

stereotypical attitudes over the years, held by teachers and absorbed by students that play a major role in the future mathematical performance of females (Banaji, Greenwald and Nosek, 2002).
A recent study demonstrated that having a female teacher who says she is anxious about mathematics leads females in her class to share that attitude and score lower on tests (Beilock, Gunderson, Ramirez, & Levine, 2010). For instance, parents tend to view mathematics as a more masculine field and buy more mathematics-related products for their sons than for their daughters (Bleeker and Jacobs, 2004; Noseket al., 2002). These messages, although unfounded scientifically, start with influential adults such as parents and teachers, are picked up and furthered by peers (Barnett and Rivers, 2004), and are reinforced by media, including magazines, television, and textbooks used in schools. When considering the long-term impact, lack of interest in mathematics among females is directly related to fewer female pursuing degrees in mathematics-related careers, including science, technology, and engineering (Linver et al., 2002; Spelke, 2005; Watt, 2006). Female interest in mathematics is markedly lower than male interest (Frenzel, Goetz, Pekrun, and Watt, 2010; Nosek, Banaji, and Greenwald, 2002.
Three practices that are regular parts of the conventional 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 classes and discussion. Given the fact that many students experience Mathematics anxiety in the traditional classroom, teachers should design classrooms 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 personalization, tiered lesson, where the students will have a 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' interest in Mathematics.

2. Statement of the Problem

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

3. 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 personalization and conventional method) on students' Interest in Mathematics.
- Ho_2: There is no significant main effect of Mathematics anxiety on students' Interest in Mathematics.
- Ho_3: There is no significant main effect of gender on students' Interest in Mathematics.
- Ho_4: There is no significant interaction effect of treatment, Mathematics anxiety and gender on students' Interest in Mathematics.

4. Research Method

4.1. 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).

4.2. 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.

4.3. Instruments

Three research instruments were used in this study. These are:

(i) Students' Mathematics Interest Questionnaire (SMIQ), (ii) Mathematics Anxiety Questionnaire and Personal Interest Inventory (PII).

4.3.1. Students' Mathematics Interest Questionnaire (SMIQ)

The SMIQ was an adapted interest scale developed and used by Holland (1959). The scale was modified to 27 items made up of two sections, that is, section A and section B. Section A consists of questions that sought background information about student's life, school, Gender and Age while Section B consists items that determined student's interest. Students' method of response to the item was the response modes of 5 point likert scale modified to 4 point scale of strongly agree, agree, disagree and strongly disagree. This was to clear out the uncertain or unsure or undecided column in order to commit students to either the positive or negative side of the issue. Testing of interest was considered to be necessary because it was found by Schiefele (1991), Renninger, Hidi, and Krapp (1992), Krapp (1999) that interest of the students in Mathematics was significantly related to their achievement in the subject. This was also supported by Su, Rounds and Armstrong (2009) who posited that it was the most appropriate and most widely adopted theoretical framework for interest measurement. The instrument was given to 80 SSS II students that were not part of the study and the reliability coefficient using Cronbach Alpha Reliability Method was found to be 0.88.

4.3.2. 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 a 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.

4.3.3. 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 of the target audience.

4.3.4. 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).

4.4. Learning Packages

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

4.4.1. 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.

4.4.2. 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 teaching 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 PII 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.

4.5. Data Collection Procedure

The research procedure was divided into three phases: (a) pre-intervention phase (b) intervention phase and (c) post-intervention phase.

4.5.1. 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 (SMIQ 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.

4.5.2. Intervention Phase

The fourth week was used for pre-test. 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 Students' Mathematics Interest Questionnaire (SMIQ). 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.

4.5.3. Post-Intervention Phase

The eleventh week was used for post-test which comprised the administration of the Students' Mathematics Interest Questionnaire (SMIQ) in both the experimental and control groups.

4.6. 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 pretest. The multiple Classification Analysis (MCA) and the Scheffe post-hoc analysis were used to explain the magnitude of the post test interest scores of the different categories of students, and to explain the direction of possible significant effects respectively.

5. 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 on students' interest in mathematics.

Table 1 reveals the result of the main effect of treatment on students' interest in Mathematics. The result showed that there was significant main effect of treatment on students' interest in Mathematics ($F_{(3, 333)} = 43.146$, $P < 0.05$). Therefore, the null hypothesis [1] is rejected.

Source of Variation	Sum of Squares	DF	Mean Square	F	Sig.
Corrected Model	19630.737	18	1090.597	15.632	.000
PREINT	4925.822	1	4925.822	70.602	.000
Main Effect:					
Treatment	6020.470	2	3010.235	43.146	.000*
Mathematics Anxiety	748.211	2	374.105	5.362	.005
Gender	115.037	1	115.037	1.649	.200
2-way Interactions:					
Treatment x Maths Anxiety	1921.911	4	480.478	6.887	.000
Treatment x Gender	12.282	2	6.141	.088	.916
Maths Anxiety x Gender	413.518	2	206.759	2.963	.053
3-way Interactions:					
Treatment x Maths Anxiety x Gender	440.409	4	110.102	1.578	.180
Error	22186.450	318	69.769		
Total	41817.187	336			

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

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

Grand Mean = 71.22					
Variable + Category	**N**	**Unadjusted variation**	**Eta**	**Adjusted for independent + covariates deviation**	**Beta**
Treatment Group:					
1.Tiered lesson	147	3.50		3.04	
2. Group Personalisation	90	-9.05		-9.78	
3. Control	100	3.00	.49	4.33	.53
Mathematics Anxiety:					
1. Low	122	.19		2.68	
2. Medium	102	1.47		.31	
3. High	113	-1.53	.11	-3.17	.22
Gender:					
1. Male	206	-.59		-.76	
2. Female	131	.93	.07	1.19	.09
Multiple R-squared					.399
Multiple R					.631

Table 2: Multiple Classification Analysis (MCA) showing the direction of the difference in the analysis: Students' Interest in Mathematics

The result reveals that with a grand mean of 71.22, the students exposed to tiered lesson package (use of tiered lesson instructional strategy) had the highest adjusted post test mean interest score of 74.71 (71.22 + 3.50). The students in the control group (use of conventional teaching method) had the next higher post test mean interest score of 74.22 (71.22 + 3.00) while the students exposed to the group personalisation package (use of group personalisation instructional strategy) obtained the least adjusted post test mean interest score of 62.17 (71.22 – 9.05). This result showed that the tiered lesson instructional strategy had the greatest potency at effecting student's interest in Mathematics. The result in Table 2 further reveals that while treatment alone accounted for 28% $(0.53)^2$ of the variation in students' interest in Mathematics, the independent and moderator variables jointly accounted for 40% $(0.631)^2$ of the variance observed in the students' interest scores in mathematics.

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

Treatment Group	(I) Treatment Groups	(J) Treatment groups	Sig
Post Student Interest in Mathematics	Treatment I	Treatment II	.000
		Control	.926
	Treatment II	Treatment I	.000
		Control	.000
	Control	Treatment I	.926
		Treatment II	.000

Table 3: Scheffe Post-Hoc Pairwise significant differences among the various Treatment groups on the Student Interest in Mathematics

It is shown in the Table 3 that there were pair significant differences between Treatment I and Treatment II, between Treatment II and Control group.

The results obtained in this study showed that there was a significant main effect of treatment on the students' interest in mathematics. The tiered lesson instructional strategy has the greatest potentials of improving the students' interest in mathematics. This may be due to the fact that students are allowed in their groups to learn on their own without the interference of the teacher. The teacher only gives the instructional package to each tier and can only come in if any of the tier is in doubt. The conventional method exhibited superiority in improving students' interest over the group personalisation instructional strategy. This may be due to the fact that students are left alone after being given an instructional package of the group personalisation strategy individually. In group personalisation strategy, students learn alone without having the opportunity to interact within themselves. This finding was in agreement with the results obtained by Okigbo and Okeke (2011), Adams (2010), John (2010), Imoko and Agwagah (2006) and Ku and Sullivan (2002).

The interaction effects were supported by the graphical illustrations below.

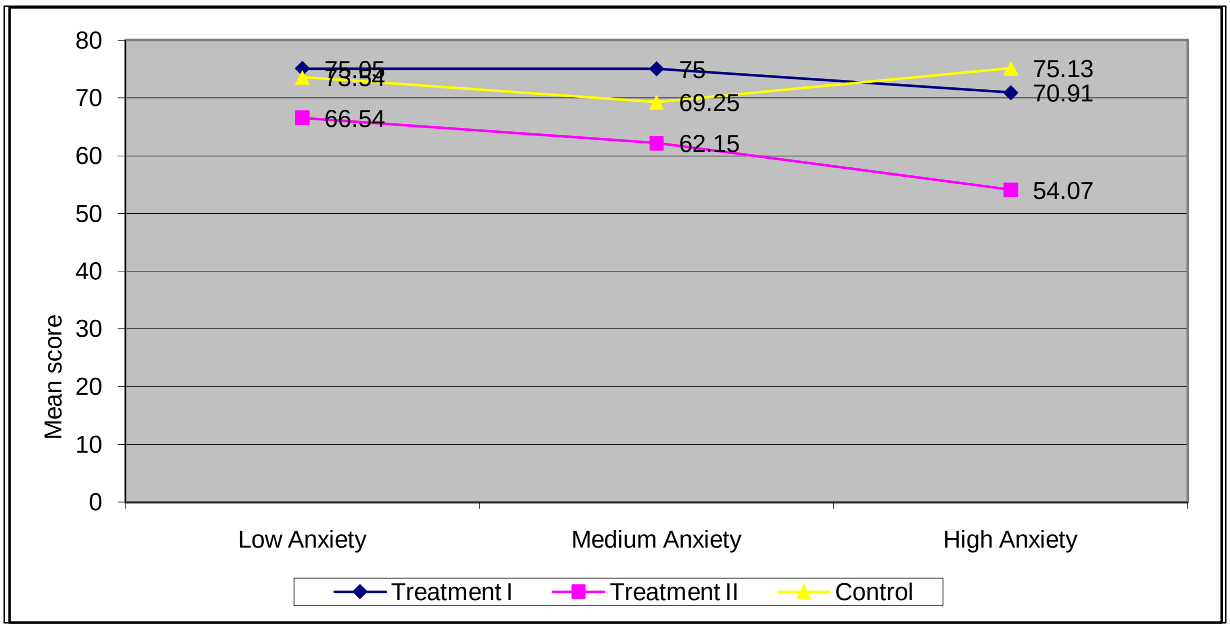

Figure 1: Interaction Effect of Treatment and Mathematics Anxiety on Interest in Mathematics

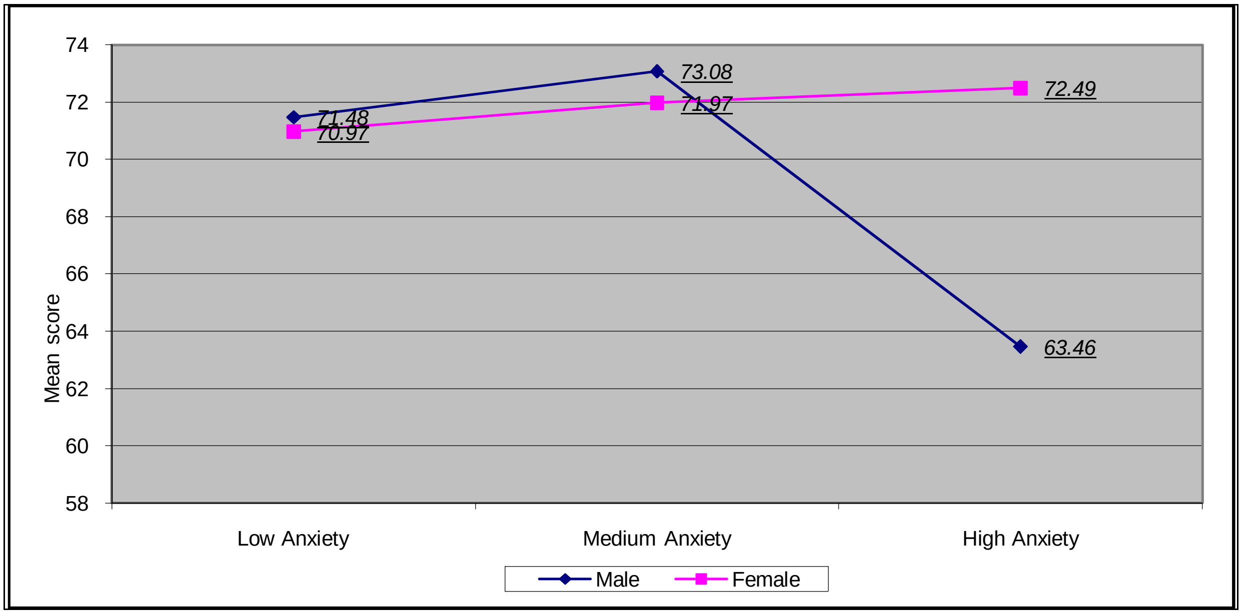

Figure 2: Interaction Effect of Mathematics Anxiety and Gender on Interest in Mathematics

- Hypothesis 2: There is no significant effect of Mathematics Anxiety (Low Anxiety, Medium Anxiety and High Anxiety) on Students' interest in Mathematics.

The result from Table 1 shows that there was a significant difference among Low, Medium and High Mathematics Anxiety in Students' Interest in Mathematics ($F_{(3,333)}$ = 5.362, P <.05). This means that the interest in mathematics of the students having low, medium and high anxiety are significantly different from one another. Hence, the hypothesis [2] is rejected. The result of (MCA) in Table 2 further reveals that the medium mathematics anxiety students ranked first in the post interest with an adjusted mean score of 72.69, low mathematics anxiety students who recorded adjusted post interest mean score of 71.41 was ranked second while the high mathematics anxiety students recorded a adjusted post interest mean score of 69.69 was ranked last. However, this difference was statistically significant. The result in Table 2 further reveals that mathematics anxiety alone accounted for 4.84% $(0.22)^2$ [less than 5%] of the variance observed in the students' interest in mathematics scores.

The results obtained in this study showed that there was a significant effect of mathematics anxiety on students' interest in mathematics. The study showed that the medium mathematics anxiety students came first, followed by low mathematics anxiety students then to the high mathematics anxiety students. These findings are in agreement with the submissions of Luo, Wang and Luo (2009), Okereke (2006), Obioma (2005) and OECD (2004).

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

The result from Table 4.4 shows that there was no significant difference in Gender (Male and Female) on Students' Interest in Mathematics ($F_{(2,334)}$ = 1.649, P >.05). This implied that the male and female students who participated in the study were not significantly different in their interest in mathematics. Hence, the null hypothesis [3] is not rejected. However, the result of the MCA in Table 2 reveals that female students who participated in the study recorded better adjusted post interest mean score of 72.15 than the males who recorded adjusted post interest mean score of 70.63. The observed difference is not, however statistically significant. The result in Table 2 further reveals that gender alone accounted for just 0.81% $(0.09)^2$ [less than 1%] of the variance observed in the students' interest in mathematics scores.

The non-significant main effect of gender on students' interest in this study conforms to the findings of Yenilmez, Girginer and Uzun (2007) and Abiam and Odok (2006), Eccles, Wigfield, Harold, and Blumenfeld (1993) but at variance with the findings of UNESCO (2008), Lichtenfeld, Frenzel, and Pekrun (2007), Frenzel, Pekrun and Goetz (2007), Opot-Okurot (2005), Watt (2004) and Fredricks and Eccles (2002).

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

The result of the 3-way interaction effects in Table 1 reveals no significant interaction effect of treatment, mathematics anxiety and gender on students' interest in mathematics. ($F_{(18,318)}$ = 1.578, P > .05). This implied that there is no significant difference between students' interest 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 not rejected.

The result in Table 2 further reveals that while treatment alone accounted for 28% $(0.53)^2$ of the variation in students' interest in Mathematics, the independent and moderator variables jointly accounted for 40% $(0.631)^2$ of the variance observed in the students' interest scores in mathematics. The non-significant 3-way interaction effect is explicable considering the finding that gender was found to produce no significant effect on the interest of students that participated in this study.

6. Conclusion

This study determined the effects of Tiered Lesson and Group Personalisation instructional strategies on Senior Secondary School Students' Interest 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' interest 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 were effective methods of learning Mathematics. Tiered instructional strategy was found to be more effective in improving students' interest in Mathematics than the conventional method while conventional method was found to be effective than a group personalization instructional strategy.

7. 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 the traditional 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 mathematics teacher education curriculum planners should design courses for designing packages in teacher training institutions where there are not presently available. The textbooks should be written in form of packages to lessen the teacher's burden in our secondary schools.

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