Acta Didactica Napocensia
Volume 6, Number 1, 2013

Effects of Framing and Team Assisted Individualised Instructional Strategies on Senior Secondary School Students' Attitudes Toward Mathematics

Adeneye O. A. Awofala, Abayomi A. Arigbabu, Awoyemi A. Awofala

Abstract: The study investigated the relative effectiveness of framing and team assisted individualised (TAI) instructional strategies on the attitudes toward mathematics of 350 senior secondary school year two Nigerian students. The moderating effects of gender and style of categorisation were also examined. The study adopted pre-test and post-test control group quasi-experimental design using a 3×2×2 factorial matrix with two experimental groups and one control group. Seven null hypotheses were tested and two research instruments, Attitudes toward Mathematics Inventory (ATMI) and Style of Categorization Test (SCT) were administered on the sample and data gathered were analysed, using analysis of covariance and Scheffe Test. The results indicated significant main effects of treatment and gender in which the participants exposed to the TAI strategy had the highest post-treatment attitudes mean score and male students had stronger attitudes toward mathematics than their female counterparts. There was no significant main effect of style of categorisation on students' attitudes toward mathematics. While there were significant two-ways interaction effects of treatment and style of categorization and gender and style of categorisation on students' attitudes toward mathematics, there was no significant interaction effect of treatment and gender on students' attitudes toward mathematics. In addition, the three-way interaction effect of treatment, gender, and style of categorization on students' attitudes toward mathematics was significant. The findings revealed that TAI and framing strategies were more effective in promoting students' attitudes toward mathematics. Thus, these instructional strategies could be used to positively change students' attitudes toward mathematics.

Key words: Framing, team assisted individualised instruction, mathematics attitudes

1. Introduction

The new millennium in Nigeria has continued to witness various reforms in the social, economic and educational sectors. In the educational sector, new policies have been formulated with the aim of meeting the challenges of primary and secondary education. In actualizing these policies and the need to situate the primary and secondary education in the context of the home grown National Economic Empowerment and Development Strategy (NEEDS), and achieving critical targets of the goals of Education for All (EFA) and the Millennium Development Goals (MDGs), the Nigerian Educational Research and Development Council (NERDC) developed a 9-year Basic Education and new Senior Secondary (SS) Curricula based on different curricula structures. At the basic education level, the curriculum is divided into three components namely, Lower basic education curriculum for primary one to three, Middle basic education curriculum for primary four to six and Upper basic education curriculum for junior secondary year one to three (Awofala, 2012). At the senior secondary school level, there are four specialized fields of study (Humanities, Science and Mathematics, Technology, and Business Studies) each made up of five compulsory cross cutting core subjects in addition to core subjects in each specialized field of study. Mathematics is one of such compulsory cross cutting core subjects. Mathematics as a creation of the human mind (Awofala & Nneji, 2012) is the language of precision (Awofala, 2010) and whetstone of creativity, thinking and problem solving needed

Received 10 April 2013, published 31 May 2013.

essentially to bring harmony, exactness, compactness and accuracy into the knowledge of science, technology, and engineering and their products.

1.1. Theoretical Background

It is evident that in spite of the compulsory status of mathematics in the National Policy on Education (revised edition, 2004) and its attendant importance in scientific and technological discoveries, senior secondary school students often exhibit poor disposition towards the subject (Okigbo & Okeke, 2011; Abakpa, & Iji, 2011) and this has been a major source of concern to mathematics and science educators. The poor disposition of students towards mathematics is a confirmation that mathematics teaching in Nigeria has not only been properly done (Awofala & Nneji, 2012) but bedeviled with several problems. Ale (1989) identified five major problems confronting school mathematics in a developing country like Nigeria to include: Curricula problems; Teacher problems; Pupil problems; Language Problems; and Infrastructural problems. Among the identified problems, teacher problem in the area of teaching ineffectiveness seems more pervasive and thus constitutes a major stumbling block to students' development of positive attitudes toward mathematics. Instructional strategies have a profound influence on students' attitudes toward mathematics (Ifamuyiwa & Akinsola, 2008). While numerous studies have investigated the effects of carefully planned instructional strategies such as concept mapping (Awofala, 2011a), brain-based learning (Awolola, 2011), mastery learning (Akinsola, 1994; Abakpa, & Iji, 2011), individualistic and cooperative teaching strategies (Akinsola, & Tella, 2003), personalization of instruction (Awofala, Balogun & Olagunju, 2011), cooperative variants of STAD and TGT (Awofala, Fatade & Ola-oluwa, 2012), and advance organizers (Ifamuyiwa, 2011) on students' achievement in mathematics in Nigeria, very few studies have investigated the efficacy of such strategies on students' attitudes toward mathematics.

One plausible explanation for this is that assessment methods of students' learning in mathematics are often geared toward the acquisition of cognitive skills with little or no preference for affective skills. This corroborates the fact that, attitude as a major construct in the affective domain is rarely assessed in school mathematics examination. Rather, assessment of students' attitudes toward mathematics is conducted in carefully controlled studies with the hope of proffering solutions to students' lackluster and poor performance/achievement in mathematics. So, researchers are preoccupied with inventing new strategies that can be manipulated to improve students' achievement in the cognitive domain. Generally, in mathematics education, instructional strategies are investigated with the hope of improving students' learning outcomes. Attitude is an important outcome in mathematics education (Ma & Kishor, 1997) which is defined implicitly and a posteriori through the instruments used to measure it (Daskalogianni & Simpson, 2000; Leder, 1985). When a definition is explicitly given, or can be inferred, attitude may refer to one of the three following types. In a simple way attitude is described as the positive or negative degree of affect associated with a certain subject or learned predispositions to respond negatively or positively to certain objects, situations, concepts or persons (McLeod, 1992; Haladyna, Shaughnessy J. & Shaughnessy M., 1983; Aiken, 1980). In a bi-dimensional definition of attitude, behaviours do not appear explicitly (Daskalogianni & Simpson, 2000), thus, attitude toward mathematics is therefore seen as the pattern of beliefs and emotions associated with mathematics (Zan & Di Martino, 2007). A multidimensional definition of attitude recognizes three components in the attitude: emotional response, beliefs regarding the subject, and behaviour related to the subject. From this point of view, an individual's attitude toward mathematics is defined in a more complex way by the emotions that he/she associates with mathematics (which, however, have a positive or negative value), by the individual's beliefs towards mathematics, and by how he/she behaves (Hart, 1989).

The latter definition is considered in this study. To achieve successful teaching of mathematics, teachers need to be aware of the students' attitudes toward mathematics. Ceteris paribus, students have continued to display negative attitudes toward the learning of mathematics (Odogwu, 2002; Georgewill, 1990) largely because teachers have continued to adopt ineffective instructional strategies (Akay & Boz, 2010) due partly to their resistance to change in methods of instruction (Awofala & Awolola, 2011) and the conviction that the traditional strategies often used by them are better adopted when dealing with large class size (Okigbo & Okeke, 2011; Obioma, 2005) which is a common phenomenon in Nigeria. The traditional strategies are conventional teaching approaches generally described as teacher-centred and didactic with learners simply listening, copying notes, doing class work and doing assignment. Among the modern instructional strategies that have been investigated in science education in Nigeria and elsewhere, Framing (Akinsola & Igwe, 2002; Orukotan, 1999; Leonard, 1989; Biggs, 1988; McAleese, 1985; Welch, 1985; Minsky, 1975) and Team Assisted Individualization (Alaiyemola, 1990; Slavin & Karweit, 1985) for this study have been found to be more promising in advancing students' achievement in school subjects.

However, little is known about the effect and efficacy of framing on students' attitudes toward mathematics in Nigeria. This might be because the Nigerian mathematics education community seems not to focus attention on the relation between framing and attitudes despite the huge success of framing as an alternative instructional strategy to the traditional method. The usefulness of framing in mathematics education in Nigeria is clearly not robust as only one study in this review reported its effectiveness on students' achievement (Awofala & Nneji, 2012). Frame, describes as a big picture or framework or grid for representing knowledge was introduced into cognitive science by Minsky (1975). He introduced it as a product of spatial learning strategy to describe the mechanism for knowledge and knowing. Framing strategy is a visual arrangement that enables a substantial amount of information to be put in a form of grid, framework, spatial or matrix. Van Pattern, Chao, and Reigeluth (1986) described framing as a cognitive strategy for sequencing and synthesising information for the purpose of designs. It is posited that since framing involves making connections of main ideas and the relationship between them, it might aid students' organization and comprehension of structural knowledge and remembering (Awofala & Nneji, 2012) thereby leading to improvement in students' attitudes.

The team assisted individualized (TAI) instruction has been found effective in facilitating mathematics performance (Slavin, 1985; Slavin & Karweit, 1985) but little is known about its effectiveness in promoting students' attitudes toward mathematics in Nigeria. TAI combines cooperative learning with individualized programmed instruction. Cooperative learning refers to learning together in small groups to effect individual accountability and a common group goal. In individualized programmed instruction, materials to be learnt are arranged and presented in small sequenced units called 'frames' that lead the learner from a body of known concept to unknown, from simple to complex concept within the same area with learners working at their pace, making frequent responses as they proceed through the materials and receiving immediate information (feedback) about the adequacy of their responses to attain mastery. TAI method uses four-six members; mixed ability learning teams and certificate are awarded to high-performing teams. It involves an individualized sequence of learning governed by a placement test thereby allowing students to proceed at their own pace. Many studies have been conducted on cooperative learning in Nigeria (Ifamuyiwa & Akinsola, 2008; Ojo, 1992; Obioma & Adibe, 1987; Okebukola & Ogunniyi, 1984) with attention recently being given to the cooperative variants of STAD, jigsaw II and TGT (Awofala, Fatade & Ola-Oluwa, 2012; Kolawole, 2008). The effectiveness of the individualized programmed instruction has also been reported in theses (Aiyelaagbe, 1998; Ajiboye, 1996). Empirical studies that combined cooperative learning with individualized instruction as in TAI are few. Given the general lack of empirical knowledge concerning the differential and comparative effects of framing strategy, TAI and conventional method on students' attitudes toward mathematics in Nigeria, the present study is set to contribute to knowledge in this area.

It is clear that the teaching of mathematics involves a system of activities deliberately and methodically created to induce students' learning of specific content and the way in which students receive and process this information will be crucial to learning and this has been found to be influenced by their styles of categorization (Awolola, 2011; Ok'wo & Otubar, 2007; Ige, 2001; Riding & Al-salih, 2000). Style of categorization is described as the way individuals think, perceive, process and remember information. Students whose style of categorization preference is similar to that of their teachers have the tendency to profit more from improved learning experience. Likewise, team members with similar style of categorization preference likely feel more positive about their participation with the team. There are various recognized style of categorization available in the literature, among which are visual/hepatic, visualizer/verbalizer, levelling/sharpening, serialist/holist, wholist/analytic, verbal/imagery and field dependent/independent, converger/diverger, adaptor/innovators (Jonassen & Grabowski, 1993). Although different instruments have been developed to assess the various forms of style of categorization identified, in the present study, the authors focus on field dependence/independence dimension. This dimension identifies an individual's perceptive behaviour while distinguishing object figures from the content field in which they are set. Witkin, Moore, Goodenough and Cox (1977) distinguished between the field dependent and field independent. The field dependent individuals rely more on external references, and focus on individual parts of an object. They tend to solve problems through common sense and intuition and use a trial-and-error approach. The field independent persons rely more on internal references, perceive objects as a whole, and tend to reduce problem situations to a set of underlying causal relationship. Learners are termed field independent if they are able to abstract an element from its context, or background field whereas field dependent learners are more likely to be better at recalling social information such as conversation and relationships and approach problems in a more global way by perceiving the total picture in a given context (Witkin & Goodenough, 1981). Some empirical findings have shown that style of categorization has significant effect on students' achievement in and attitudes toward mathematics (Awofala, Balogun & Olagunju, 2011; Awolola, 2011; Peklaj, 2003; Awofala, 2002) while others have acknowledged that both field dependent and field independent students achieved equally on learning outcomes (Adegoke, 2011; Ige, 2001). This inconsistency in literature regarding style of categorization warrants further investigation in this study. Thus, in the present study, the authors posit that if metacognitive and cooperative learning strategies such as framing and TAI respectively are used to teach mathematics, students could be empowered to take charge of their own learning in a highly meaningful fashion; increase their store of mathematical knowledge and enhance remembering and transfer of learned content to novel situations. Such students are likely to display an enhanced level of performance and attitudes irrespective of their style of categorization and gender.

Gender was included as a moderator variable of interest in this study because past studies in Nigeria had indicated gender as one of the most important variables in mathematics education (Abakpa & Iji, 2011; Abiam & Odok, 2006) with inconclusive report findings (Abakpa & Iji, 2011; Akinsola & Awofala, 2009). Reported findings in gender had been mixed with some claiming that males showed more positive attitudes toward mathematics and science and performed better on achievement measure than their female counterparts (Awofala, 2011b; Awofala, 2010; Ogunneye, 2003; Akinsola & Awofala, 2009) while others (Abakpa & Iji, 2011; Ogunleye & Babajide, 2011; Arigbabu & Mji, 2004; Agommuoh & Nzewi, 2003) observed no significant effect of gender on students' achievement in and attitudes toward science and mathematics thus concluding that gender differences in attitudes and achievement/performance might be disappearing.

The present study was undertaken to investigate the differential effects of framing and team assisted individualised instructional strategies on senior secondary school students' attitudes toward mathematics. It also examined the influence of gender and style of categorization on students' attitudes toward mathematics.

1.2. Research Questions

The following null hypotheses were tested at 0.05 level of significance in order to provide answers to the problems raised in the study.

Ho_1: There is no significant main effect of treatment on students' attitudes toward mathematics.

Ho_2: There is no significant main effect of gender on students' attitudes toward mathematics.

Ho_3: There is no significant main effect of style of categorisation on students' attitudes toward mathematics.

Ho_4: There is no significant interaction effect of treatment and gender on students' attitudes toward mathematics.

Ho_5: There is no significant interaction effect of treatment and style of categorisation on students' attitudes toward mathematics.

Ho_6: There is no significant interaction effect of gender and style of categorisation on students' attitudes toward mathematics.

Ho_7: There is no significant interaction effect of treatment, gender, and style of categorisation on students' attitudes toward mathematics.

1. 3. The Conceptual Framework

This study was premised on the conceptual framework of Systems Approach (Joyce & Weil, 1980), which sees the teaching and learning process as consisting of inputs and outputs in which the quality of inputs determine the quality of outputs. The study was also premised on the assumption that students' failures are a consequence of poor quality instruction and not a function of lack of student's ability to learn (Levine, 1985; Bloom, 1981). The learning outcomes in this study are attitudes toward mathematics considered as the outputs of instructions and which could be influenced by various factors including learner characteristics, classroom environment and teacher characteristics. These factors are the intervening variables which required being controlled in the study. Teacher training determines the efficiency of a teacher and his/her choice of strategies and effectiveness in handling the various teaching strategies in the classroom. The learners' age and hence their class determine the curricular contents they are taught. The type of school as a teaching environment influences the learning outcomes. The type of school used was coeducational in order to control the effect of the classroom environment. Senior secondary school year two students who were approximately of the same age were involved in the study. The study made use of professionally qualified mathematics teachers to control the teacher variable. In this study therefore, the teaching strategy adopted influenced the learning outcomes.

2. Method

2.1. Research Design

The study adopted a quantitative research within the blueprint of pre-test, post-test non-equivalent control group quasi-experimental design to contrast the treatment's (at three levels) scores crossed with style of categorization (at two levels) and gender (at two levels) using a 3×2×2 factorial matrix. The research design is symbolically presented below:

O_1	X_1	O_2	$X_{1\ gain} = O_2 - O_1$	$O_1\ O_3\ O_5$ = pre-tests
O_3	X_2	O_4	$X_{2\ gain} = O_4 - O_3$	$O_2\ O_4\ O_6$ = post-tests
O_5	C	O_6	$C_{gain} = O_6 - O_5$	

X_1, X_2 and C represent framing treatment, TAI treatment and conventional teaching method respectively. The mean gain scores between O_1 and O_2, O_3 and O_4 and O_5 and O_6 were tested for statistical significance using the Analysis of Covariance (ANCOVA).

2.2. Participants

The participants comprised 350 Senior Secondary School year two general mathematics students (172 males and 178 females) of varied style of categorization (181 field independents and 169 field dependents). Simple random sampling was used to select one intact class each from six equivalent coeducational secondary schools that were distantly located from one another within the city of Lagos, Nigeria. We randomly assigned two schools to the framing strategy, two schools to the TAI and the remaining two schools to the conventional method. The mean ages of the students in the framing schools, TAI schools and conventional method schools were 15.4 years, 15.6years and 15.5 years respectively.

2.3. Instrumentation

2.3.1. Attitudes toward Mathematics Inventory

We measured students' attitudes toward mathematics by the Attitudes toward Mathematics Inventory (ATMI) which is an instrument adapted from TIMSS 2003 grade 8 students' Questionnaire and other researchers (Orhun, 2007; Kadijevich, 2006; Tapia & Marsh II, 2004; Fennema & Sherman, 1977). It consisted of two parts. Part A seeks information on students' demographic variables such as age, gender, type of school, and name of school. Part B consists of a group of four instruments: (1) self-confidence in learning mathematics scale, (2) liking mathematics scale, (3) usefulness of mathematics scale, and (4) mathematics anxiety scale and altogether contain 25 items and take 11 minutes on the average to complete. In this study, attitude toward mathematics is composed of four dimensions as explained below:

(1) self-confidence denotes perceived ease, or difficulty, of learning mathematics (e.g. ''I usually do well in mathematics'').

(2) liking stands for student's affective, emotional and behavioural reactions concerning liking or disliking mathematics (e.g. ''I enjoy learning mathematics'').

(3) usefulness denotes student's beliefs concerning the contribution of mathematics to his/her educational and career performance ('' I need to do well in mathematics for my future work'').

(4) anxiety denotes deeper attitude of feelings of tension and discomfort that interfere with the manipulation of mathematics (e.g. ''I am always worried and impatient when I think of solving mathematics'').

Each item of the ATMI is rated on a five-point modified Likert scale ranging, from Undecided – 0, Strongly agree - 1, Agree - 2, Disagree – 3 to Strongly disagree – 4 for each negatively worded statement and the score is reversed for every positive statement with the weighting ascribed to Undecided used as the starting point in both cases. Cronbach's alpha coefficients of 0.78, 0.86, 0.77, and 0.84 were found for the dimensions of self-confidence, liking, usefulness and anxiety respectively. Two weeks test-retest reliability of the ATMI using the Pearson Product Moment Correlation gave a coefficient of stability, 0.74.

2.3.2. Style of Categorisation Test (SCT)

There are various forms of style of categorization with different instruments developed to assess them. Oltman, Raskin, and Witkin's (1982) Group Embedded Figures Test (GEFT) has been used most often. Apart from the general application of GEFT, the choice of this instrument in this study is premised on three reasons: First, the GEFT is a non-verbal test thus requiring only a minimum level of language skill for performing the tasks. Second, the psychometric properties of the instrument have been assessed in cross-cultural settings and adjudged quite reasonable. Third, the GEFT has been adapted and validated for Nigerian use (Adegoke, 2011). The GEFT was used in this study to classify participants into field independent or field dependent based on their scores on the test. The test has three sections. The first section which contained seven items was given for practice purposes while both the second and the third sections included nine items and altogether has a total completing time of 12 minutes. The GEFT required each participant to trace a specified simple figure that was embedded within a complex design and a participant's total score was formed by a number of simple figures correctly traced in sections two and three of the test. The possible score that a participant could get ranged from zero to 18.

In this study, participants were classified into three different groups on the basis of their results on GEFT: field dependent (FD) students (with achievement lower than first quartile), students with indistinctive style of categorization (with achievement between the first and the third quartile), and field independent (FI) students (with achievement higher than third quartile). Prior to the experiment, GEFT was administered to 360 students who were members of the six classes that were sampled. Based on their scores on GEFT, 181 students emerged as field independents, 169 students as field dependents and 10 students with indistinctive style of categorization. The mean score of field independent students on GEFT was 12.16 while the mean score of the field dependents on the test was 3.85. An independent samples t-test analysis showed significant difference in the mean score on GEFT between the field dependent and field independent students ($F(2,348) = 13.68$, $p<0.05$). This result showed that the two groups did have significantly different style of categorization based on FI/FD. The SCT was revalidated through test- retest method leaving an interval of two weeks between the first and second administration. Data collected were correlated using the Pearson Product Moment Correlation and a test-retest reliability coefficient of 0.74 was obtained.

2.4. Procedure

The authors only sensitized the six willing teachers in the use of the different instructional strategies. Four of the willing teachers attended a graduate-level course in classroom methodology where they were trained in the use of framing and TAI instructional strategies respectively. At the outset of the study, the teachers made the students respond to two instruments i.e. Attitudes toward Mathematics Inventory (ATMI) and Style of Categorization Test (SCT). The scores on the ATMI administered before the treatment served as the covariates while the SCT served to categorize the students into the extremes of the style of categorization continuum of field independence and field dependence. After this, the teacher provided the treatment conditions, which lasted four weeks. This involved the use of Framing in two schools (experimental group 1), the use of Team Assisted Individualized instruction in two schools (experimental group 2) and the use of Conventional teaching method in the remaining two schools (control group). Thereafter, the ATMI was also administered.

The treatment for the experimental groups was carried out using a specially designed Instructional Guide (IG) for mathematics, while the conventional method of teaching was used for the control group. The IG involved the following specific phases:

1. Introduction – Identification of topics, concepts, subtopics and instructional objectives. Introducing the strategy as well as holding brief remarks on them.
2. Presentation of theoretical base involving lectures or discussions.
3. Implementation of Strategy – carrying out of specific treatment, either framing or TAI.
4. Evaluation of learning and consolidation of knowledge gained.

In the experimental group I (n = 115) students were taught mathematics using the framing technique. The teacher gave a brief description of frame and also constructed sample frames for the students using a mathematics concept. The students were made to identify and list main ideas, principles, concepts, examples etc. in quadratic expressions and quadratic equations. The teacher gave introductory remarks and presented context summaries from facts isolated by the students, they pointed out relationship between the listed ideas, concepts and generalizations, which were in the form of forms/function, comparison/contrasts. Students then labeled the row and columns with any of the relationships in the preceding step to form a grid and lastly the teachers observed and reviewed the activities done to effect necessary correction/ feedback where applicable.

In the experimental group II (n = 126) students were divided into six-member groups that were heterogeneous with regard to academic ability, style of categorization as well as sex and were placed in an individual sequence of the mathematics learning material on quadratic expressions and quadratic equations based on test performance. Using teamwork and individualized programmed instruction, the students proceed at their own pace, but their group checked daily practice sheets with their activities timed by the teacher. Students earned points for their respective groups by passing the final test. Thereafter, the students took their final unit tests individually and were scored by the teacher during the class. The teacher summed up the number of units completed by each group and total marks obtained by all group members. The group with the highest score was rewarded with a certificate of performance.

The control group (n = 109) was taught mathematics using the conventional teaching method of chalk and talk. The conventional instruction involved lessons with lecture and questioning methods to teach the concept of quadratic expressions and quadratic equations. The teacher posed problems on the chalkboard and solved them with explanations. In the better part of the instruction time, the students received instruction and engaged in discussions arising from the teacher's explanations and questions. Thus, in the control group, teaching was teacher dominated with students listening and copying notes.

2.5. Data Analysis

The post-treatment attitudes scores were subjected to analysis of covariance using the pre-treatment attitudes scores as covariates. Scheffe test was used in the post hoc contrasts of the groups' post-treatment attitudes mean scores.

3. Results

Table 1 below showed the results of statistical analysis of post-treatment attitudes scores among the two experimental and one control groups according to gender and style of categorisation.

Table 1. *Results of statistical analysis of post-treatment attitudes scores based on gender and style of categorisation*

Treatment	Gender	SCT	Mean	Std. Deviation	N
Traditional Method	Male	Field Dependence	93.2667	9.70579	30
		Field Independence	85.7500	13.37943	28
		Total	89.6379	12.12754	58
	Female	Field Dependence	96.7931	8.14327	29
		Field Independence	81.2727	15.79084	22
		Total	90.0980	14.21725	51
	Total	Field Dependence	95.0000	9.07060	59
		Field Independence	83.7800	14.51008	50
		Total	89.8532	13.08648	109
TAI Strategy	Male	Field Dependence	92.1622	6.30922	37
		Field Independence	98.4474	6.98530	38
		Total	95.3467	7.33281	75
	Female	Field Dependence	94.3478	5.11334	23
		Field Independence	89.1786	8.81520	28
		Total	91.5098	7.75983	51
	Total	Field Dependence	93.0000	5.93182	60
		Field Independence	94.5152	9.02005	66
		Total	93.7937	7.71318	126
Framing Strategy	Male	Field Dependence	94.6667	8.88488	18
		Field Independence	97.9524	11.43449	21
		Total	96.4359	10.33847	39
	Female	Field Dependence	86.3750	8.84545	32
		Field Independence	95.3409	8.90243	44
		Total	91.5658	9.88107	76
	Total	Field Dependence	89.3600	9.64632	50
		Field Independence	96.1846	9.77863	65
		Total	93.2174	10.25789	115
Total	Male	Field Dependence	93.0824	8.15360	85
		Field Independence	94.2414	11.92707	87
		Total	93.6686	10.22441	172
	Female	Field Dependence	92.1548	8.95840	84
		Field Independence	90.2128	12.13178	94
		Total	91.1292	10.76614	178
	Total	Field Dependence	92.6213	8.55019	169
		Field Independence	92.1492	12.16894	181
		Total	92.3771	10.56515	350

The mean of the post-treatment attitudes scores for the Team Assisted Individualisation (TAI) group *(M=93.79, SD=7.71)* was slightly higher than the mean of the Framing Strategy (FRS) group *(M=93.21, SD=10.26)* but higher than the mean of the Traditional Method (TM) group *(M=89.85, SD=13.09)*. These results connote that the students in the TAI and FRS groups held stronger attitudes toward mathematics than their counterparts in the TM group. This is in line with the submission that the learner-centred instructional strategies such as the framing and team-assisted individualisation might improve the attitudes of students toward mathematics. These results linked the null hypothesis one stated below.

3.1. Null Hypothesis One: There is no significant main effect of treatment on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of the students in the two experimental and one control groups using the Analysis of Covariance as contained in Table 2 below showed that the difference in means among the three groups was statistically significant ($F_{(2,349)}=7.43,\ p=0.001,\ \eta^2_p=0.42$). The significant result at a level of $p<0.05$ meant that there was a less than 5% chance that the result was just due to randomness. The flip side of this was that there was a 95% chance that the difference in post-treatment attitudes scores among the three groups was a real difference and not just due to chance. As observed in Table 2 below, the two-tailed p value was 0.001 meaning that random sampling from identical populations would lead to a difference smaller than was observed in 99% of experiments and larger than was observed in 1% of experiments. Thus, the null hypothesis one was rejected and we upheld that there was a significant main effect of treatment on students' attitudes toward mathematics.

Table 2. *Summary of Analysis of Covariance of Attitudes toward Mathematics Inventory Scores by Treatment, Gender and Style of Categorization (SCT)*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	8610.896[b]	12	717.575	7.97	.000*	.221	95.628	1.000
Intercept	34396.996	1	34397.0	382.0	.000*	.531	381.996	1.000
Pre-attitude score	15.003	1	15.003	.17	.683	.000	.167	.069
Treatment (T)	1337.808	2	668.904	7.43	.001*	.042	14.857	.940
Gender (G)	830.365	1	830.365	9.22	.003*	.027	9.222	.857
SCT	220.456	1	220.456	2.45	.119	.007	2.448	.345
T*G	334.002	2	167.001	1.86	.158	.011	3.709	.386
T*SCT	4315.803	2	2157.90	23.97	.000*	.125	47.929	1.000
G*SCT	439.133	1	439.133	4.88	.028*	.014	4.877	.596
T*G*SCT	1065.129	2	532.564	5.91	.003*	.034	11.829	.875
Error	30345.321	337	90.045					
Total	3025694.0	350						
Corrected Total	38956.217	349						

[a]Computed using alpha = .05, [b]R Squared = .221 (Adjusted R Squared = .193), *Significant at p<0.05

The results from post-hoc analysis (Table 3) indicated that the mean attitudes toward mathematics scores of the students taught with the framing strategy were significantly higher than those taught with the traditional method. Also, the mean attitudes toward mathematics scores of students taught with the team-assisted individualisation were significantly higher than those taught with the traditional method. However, the main source of observed significant difference was due to the significant difference between the TAI and TM groups and between the FRS and TM groups. The difference between the mean post-treatment attitudes scores of students in the FRS and TAI groups was statistically not significant. Therefore, the TAI strategy was the most efficient of the treatment conditions and the direction of decreasing effect of instructional strategy on attitudes toward mathematics is CGS< FRS< TAI.

Table 3. *Scheffe Comparisons of Treatment Groups' Mean Score on ATMI*

(I) Treatment	(J)Treatment	Mean difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Upper Bound	Lower Bound
TM	TAI	-3.9404(*)	1.23974	.007	-6.9885	-.8924
	FRS	-3.3642(*)	1.26694	.031	-6.4791	-.2492
TAI	TM	3.9404(*)	1.23974	.007	.8924	6.9885
	FRS	.5763	1.22228	.895	-2.4289	3.5814
FRS	TM	3.3642(*)	1.26694	.031	.2492	6.4791
	TAI	-.5763	1.22228	.895	-3.5814	2.4289

*The mean difference is significant at the .05 level.

Table 1 showed the results of statistical analysis of post-treatment attitudes scores based on gender. The mean of the post-treatment attitudes scores for the male students *($M=93.67$, $SD=10.22$)* was higher than the mean of their female counterparts *($M=91.13$, $SD=10.77$)*. This result meant that male students held stronger attitudes toward mathematics than their female counterparts. This result seemed to buttress the fact that gender inequity in mathematics education might not be over yet. This result linked the null hypothesis two stated below.

3.2. Null Hypothesis Two: There is no significant main effect of gender on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of male and female students using the Analysis of Covariance as contained in Table 2 above showed that the difference in means between the male and female students was statistically significant ($F_{(1,349)}=9.22$, $p=0.003$, $\eta^2_p=0.27$). The significant result at a level of $p<0.05$ meant that there was a less than 5% chance that the result was just due to randomness. The flip side of this was that there was a 95% chance that the difference in post-treatment attitudes scores between the male and female students was a real difference and not just due to chance. As observed in Table 2 above, the two-tailed p value was 0.003 meaning that random sampling from identical populations would lead to a difference smaller than was observed in 97% of experiments and larger than was observed in 3% of experiments. Thus, the null hypothesis two was rejected and we upheld that there was a significant main effect of gender on students' attitudes toward mathematics.

Table 1 above showed the results of statistical analysis of post-treatment attitudes scores based on students' style of categorisation.

The mean of the post-treatment attitudes scores for the field dependent (FD) students *($M=92.62$, $SD=8.55$)* was slightly higher than the mean of their field independent counterparts *($M=92.15$, $SD=12.17$)*. This result means that the field dependent students held almost the same attitudes toward mathematics with their field independent counterparts. This result seemed to buttress the fact that differences in style of categorisation might not be a factor in students' attitudes toward mathematics. This result linked the null hypothesis three stated below.

3.3. Null Hypothesis Three: There is no significant main effect of style of categorisation on students' attitudes toward mathematics

Further analysis of the post-treatment attitudes scores of field independent and field dependent students using the Analysis of Covariance as contained in Table 2 above showed that the difference in means between the field independent and field dependent students was statistically not significant ($F_{(1,349)}=2.45$, $p=0.12$, $\eta^2_p=0.07$). Thus, the null hypothesis three was not rejected and we upheld that there was no significant main effect of style of categorisation on students' attitudes toward mathematics.

Table 1 above showed the results of statistical analysis of post-treatment attitudes scores based on treatment and gender.

In the traditional method group, the female students recorded higher post-treatment attitude mean score (*M=90.10, SD=14.22*) than their male counterparts (*M=89.64, SD=12.13*) whereas in both the TAI and FRS groups male students obtained higher post-treatment attitude mean score (*M=95.35, SD=7.33; M=96.44, SD=10.34*) than their female counterparts (*M=91.51, SD=7.76; M=91.57, SD=9.88*) respectively. These results connote that in the teacher-centred strategy (i.e. TM) group female students seemed to display stronger attitudes toward mathematics than their male counterparts whereas in the students-centred strategy (i.e. TAI & FRS) groups male students showed the tendency to possess stronger attitudes toward mathematics than their female counterparts. These results linked null hypothesis four stated below.

3.4. Null Hypothesis Four: There is no significant interaction effect of treatment and gender on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of the interaction of treatment (TM, FRS & TAI) and gender (male & female) using the Analysis of Covariance as contained in Table 2 above showed that the interaction effect of treatment and gender was not statistically significant ($F_{(2,349)}=1.86$, $p=0.16$, $\eta^2_p=0.01$). Thus, the null hypothesis four was not rejected and we upheld that there was no significant interaction effect of treatment and gender on students' attitudes toward mathematics.

Table 1 above showed the results of statistical analysis of post-treatment attitudes scores of students based on treatment and style of categorisation.

In the traditional method group, the field dependent students recorded higher post-treatment attitude mean score (*M=95.00, SD=9.07*) than their field independent counterparts (*M=83.78, SD=14.51*) whereas in both the TAI and FRS groups field independent students obtained higher post-treatment attitude mean score (*M=94.52, SD=9.02; M=96.18, SD=9.78*) than their field dependent counterparts (*M=93.00, SD=5.93; M=89.36, SD=9.65*) respectively. These results mean that in the teacher-centred strategy (i.e. TM) group the field dependent students seemed to bolster stronger attitudes toward mathematics than their field independent counterparts whereas in the students-centred strategy (i.e. TAI & FRS) groups field independent students were more inclined to hold stronger attitudes toward mathematics than their field dependent counterparts. These results linked null hypothesis five stated below.

3.5. Null Hypothesis Five: There is no significant interaction effect of treatment and style of categorisation on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of the interaction of treatment (TM, FRS & TAI) and style of categorisation (field dependent & field independent) using the Analysis of Covariance as contained in Table 2 above showed that the interaction effect of treatment and style of categorisation was statistically significant ($F_{(2,349)}=23.97$, $p<0.000$, $\eta^2_p=0.125$).

The significant result at a level of $p<0.05$ meant that there was a less than 5% chance that the result was just due to randomness. The flip side of this was that there was a 95% chance that the difference in post-treatment attitudes scores between the field dependent and field independent students in the different treatments (TM, FRS & TAI) groups was a real difference and not just due to chance. As observed in Table 2 above, the two-tailed p value was 0.000 meaning that random sampling from identical populations would lead to a difference smaller than was observed in 100% of experiments and larger than was observed in 0% of experiment. Thus, the null hypothesis five was rejected and we upheld that there was a significant interaction effect of treatment and style of categorisation on students' attitudes toward mathematics.

Further analysis using the line graph (Figure 1 below) provides illustration on the nature of the significant interaction effect of treatment and style of categorisation on students' attitudes toward mathematics.

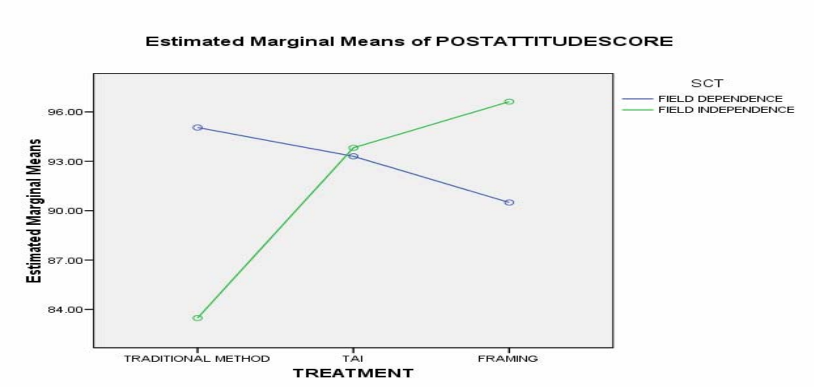

Figure 1. *Interaction of effect of treatment and style of categorisation on students' attitudes toward mathematics*

Table 1 above showed the results of statistical analysis of post-treatment attitudes scores of students based on gender and style of categorisation.

The field independent male students recorded higher post-treatment attitude mean score (*M=94.24, SD=11.93*) than the field dependent male students (*M=93.08, SD=8.15*) whereas the field dependent female students obtained higher post-treatment attitude mean score (*M=92.15, SD=8.96*) than the field independent female students (*M=90.21, SD=12.13*). These results mean that male students who were field independent seemed to bolster stronger attitudes toward mathematics than when they displayed field dependency whereas female students who were field dependent showed more inclination to hold stronger attitudes toward mathematics than when they exhibited field independency. These results linked null hypothesis six stated below.

3.6. Null Hypothesis Six: There is no significant interaction effect of gender and style of categorisation on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of the interaction of gender (female & male) and style of categorisation (field dependent & field independent) using the Analysis of Covariance as contained in Table 2 above showed that the interaction effect of gender and style of categorisation was statistically significant ($F_{(1,349)}=4.88, p=0.03, \eta^2_p=0.14$).

The significant result at a level of $p<0.05$ meant that there was a less than 5% chance that the result was just due to randomness. The flip side of this was that there was a 95% chance that the difference in post-treatment attitudes scores between male and female students who were field dependent and field independent was a real difference and not just due to chance. As observed in Table 2 above, the two-tailed p value was 0.003 meaning that random sampling from identical populations would lead to a difference smaller than was observed in 97% of experiments and larger than was observed in 3% of experiment. Thus, the null hypothesis six was rejected and we upheld that there was a significant interaction effect of gender and style of categorisation on students' attitudes toward mathematics.

Further analysis using the line graph (Figure 2 below) provides illustration on the nature of the significant interaction effect of gender and style of categorisation on students' attitudes toward mathematics.

Table 1 above showed the results of statistical analysis of post-treatment attitudes scores of students based on treatment, gender and style of categorisation.

In the traditional method group, the field dependent male students recorded higher post-treatment attitude mean score (*M=93.27, SD=9.71*) than the field independent male students (*M=85.75, SD=13.38*). More so, in the traditional method group the field dependent female students obtained higher post-treatment attitude mean score (*M=96.79, SD=8.14*) than the field independent female students (*M=81.27, SD=15.79*). These results showed that the field dependent male and female students taught with the traditional method tended to hold stronger attitudes toward mathematics than the field independent male and female students taught with the traditional method. In the TAI group, the field independent male students recorded higher post-treatment attitude mean score (*M=98.45, SD=6.99*) than the field dependent male students (*M=92.16, SD=6.31*) whereas in the same TAI group the field dependent female students obtained higher post-treatment attitude mean score (*M=94.35, SD=5.11*) than the field independent female students (*M=89.18, SD=8.82*). These results indicated that the field independent male students taught with the TAI tended to exhibit stronger attitudes toward mathematics than the field dependent male students taught using the same strategy whereas the field dependent female students taught using the TAI were more inclined to hold stronger attitudes toward mathematics than the field independent female students taught with the TAI. In the FRS group, the field independent male students recorded higher post-treatment attitude mean score (*M=97.95, SD=11.43*) than the field dependent male students (*M=94.67, SD=8.88*). More so, in the FRS group the field independent female students obtained higher post-treatment attitude mean score (*M=95.34, SD=8.90*) than the field dependent female students (*M=86.38, SD=8.85*). These results meant that the field independent male and female students taught with the FRS seemed to bolster stronger attitudes toward mathematics than the field dependent male and female students taught with the FRS. These results linked null hypothesis seven stated below.

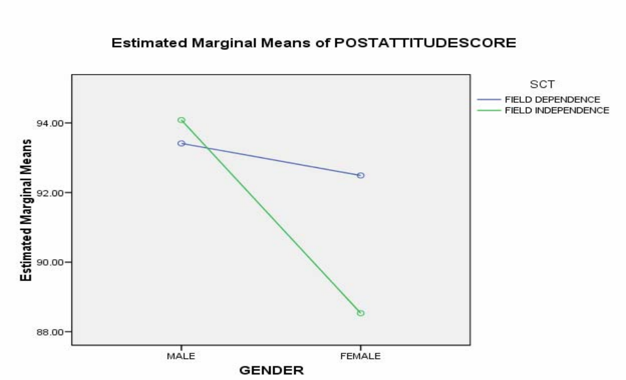

Figure 2. *Interaction of effect of gender and style of categorisation on students' attitudes toward mathematics*

3.7. Null Hypothesis Seven: There is no significant interaction effect of treatment, gender and style of categorisation on students' attitudes toward mathematics.

Further analysis of the post-treatment attitudes scores of the interaction of treatment (TM, FRS & TAI), gender (female & male) and style of categorisation (field dependent & field independent) using the Analysis of Covariance as contained in Table 2 above showed that the interaction effect of treatment, gender and style of categorisation was statistically significant $(F_{(2,349)} = 5.91,\ p=0.003,\ \eta^2_p=0.34)$.

The significant result at a level of $p<0.05$ meant that there was a less than 5% chance that the result was just due to randomness. The flip side of this was that there was a 95% chance that the difference in post-treatment attitudes scores between male and female students who were field dependent and field independent was a real difference and not just due to chance. As observed in Table 2 above, the two-tailed p value was 0.003 meaning that random sampling from identical populations would lead to a difference smaller than was observed in 97% of experiments and larger than was observed in 3% of experiment. Thus, the null hypothesis seven was rejected and we upheld that there was a significant interaction effect of treatment, gender and style of categorisation on students' attitudes toward mathematics.

Further analysis using the line graphs (Figures 3a & 3b below) provide illustration on the nature of the significant interaction effect of treatment, gender and style of categorisation on students' attitudes

toward mathematics. However, the overall percentage contribution of all the variables (composite) to the variance of students' attitudes toward mathematics was 0.221 × 100% = 22.1%

Figures 3a and 3b. *Interaction of effect of treatment, gender and style of categorisation on students' attitudes toward mathematics*

4. Discussion and Conclusions

The results presented in Table 2 showed significant main effects of treatment and gender on students' attitudes toward mathematics and that the 4.2% and 2.7% of the variance in students' attitudes toward mathematics could be explained by treatment and gender respectively. The results indicate that students' attitudes were greatly improved when they were exposed to the teaching strategies of framing and team-assisted individualisation when compared with the traditional method. This finding supports earlier findings (Awofala, 2011a; Awolola, 2011; Akay & Boz, 2010; Akinsola & Awofala, 2009; Nicolaou & Philippou, 2004; Akinsola & Tella, 2003; English, 1997; Silver, Mamona-Downs, Leung & Kenney, 1996; Silver, 1994; Brown & Walter, 1993) which associate improved content learning and attitudes to learner-centred teaching strategy. This is further substantiated considering the fact that the learner-centred teaching strategies alleviate misunderstandings about the nature of mathematics (Akay & Boz, 2010), and in the present study the teaching strategies of framing and team-assisted individualisation made the students more confident, increased their liking of mathematics and reduced anxiety toward mathematics when compared with the traditional teaching method. The traditional teaching method has not only been criticized for emphasizing teacher activity at the expense of pupil involvement (Ige, 2001) but that it has a negative effect on students' attitudes toward mathematics (Akay & Boz, 2010).

Framing strategy was found to be effective in promoting attitudes toward mathematics in this study because the strategy provided learners with opportunity to spend their time more efficiently, increase their attention span and liking of mathematics, reduce anxiety, and become more confident following instruction. Research findings have indicated that framing strategy can promote students' achievement significantly in subject content (Awofala & Nneji, 2012; Akinsola & Igwe, 2002; Ekwere, 1998; Levin, Alglin, & Carrey, 1987; Dreher & Singer, 1980) thereby increasing their attitudes. This is because the strategy guides learners better in their learning and assists them in recalling important information with less anxiety. Framing strategy as used in this study enabled the students to bring out the frames in the content of study thereby stimulating them to develop connections of main ideas and the relationship between them. With this, learning is made more meaningful, attitude is improved and student's understanding is enhanced. Team assisted individualized instruction was found to be more effective than the traditional method in this study because students had the opportunity to work together in teams, share views and opinions, and engage in brainstorming on problems which aided their attitudes toward mathematics. This supports the assertion of Slavin (1980, 1982, 1983a, 1983b, 1984, 1995) regarding the effectiveness of the incentive and task structure associated with every cooperative learning variant, the TAI inclusive. Similar studies have associated the effectiveness of the cooperative learning variant to the opportunity it gives students to discuss, solve problems, create solutions, provide ideas, help each other and improve attitudes (Awofala, Fatade & Ola-Oluwa, 2012; Zakaria, Chin & Daud, 2010; Tarim & Akdeniz, 2008).

The main significant main effect of gender on students' attitudes toward mathematics in this study (Table 1) is in line with the results of previous studies (Casey, Nuttall, & Pezaris, 2001; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Ma, & Kishor, 1997; Sayers, 1994; Vermeer, Boekaerts, &

Seegers, 2000). These studies reported that there are gender differences in attitude towards mathematics with girls showing more negative attitudes than boys. In general these studies noted that compared with boys, girls lacked confidence, had debilitating causal attribution patterns, perceived mathematics as a male domain, and were anxious about mathematics. The present study result on gender differences in attitudes toward mathematics also support the work of researchers who believe that gender stereotyping is still dominant in the Nigerian educational system (Awofala, 2011b; Awofala, 2007; Erinosho, 1997). Gender based differences are due to the individual's perception of own abilities and the sex role (Schiefele & Csikszentmihalyli, 1995). However, the result is at variance with the findings of some previous studies (Fatade, Nneji, Awofala, & Awofala, 2012; Arigbabu & Mji 2004) that reported no significant main effect of gender on students' performance in science and mathematics. The result of the present study suggests the existence of differential experiences of boys and girls within and outside the classroom and that gender differences in mathematics attitudes might not have all disappeared. Poor attitude towards mathematics has often been cited as one factor that has contributed to lower participation and success of girls in mathematics (Willis, 1995; Fullarton, 1993). Thus, interest and attitude in the subject seem to predict students' participation and success in the subject. Costello (1991) reported that almost all literature on gender differences in mathematics learning points to the commonly held perception that doing mathematics is consistent with a male self-image and inconsistent with a female self-image. This self image is somewhat caused by the peer pressure (Farooq & Shah, 2008) and most secondary school girls don't actively participate in mathematics classes due to their poor perceptions about mathematics. Girls are found to be negatively influenced by their sex-role stereotypes (Ethington, 1992; Sherman, 1982; Leder, 1982; Fennema & Sherman, 1977).

The non-significant main effect of style of categorization on students' attitudes toward mathematics (Table 1) is in line with previous studies (Adegoke, 2011; Ige, 2001) but at variance with those of (Awolola, 2011; Awofala, Balogun & Olagunju, 2011) who believe that processing of information in an analytic as opposed to non-analytic way improves achievement in and attitudes toward content learning greatly. The present study proved that experiencing events in an undifferentiated way linked to the field dependent students contributed equally to improvement in attitudes toward mathematics when compared to the field independent students. Thus, in this study, the recurring pattern of perceptual and intellectual activity termed style of categorization did not result in mathematics attitudes differential between the field dependent and field independent students.

The results of this study showed that there was no significant interaction effect of treatment and gender on students' attitudes toward mathematics but the two-ways interaction effects of treatment and style of categorisation and gender and style of categorization on students' attitudes toward mathematics were statistically significant. The non-significant interaction effect of treatment and gender recorded in this study showed gender seemed not to interact with instruction to produce results, meaning that the treatment conditions did not discriminate across gender in this study. The significant interaction effect of treatment and style of categorization recorded in this study showed that students with different styles of categorization might respond differently to the content being presented, instructional strategy being adopted as well as the learning environment and that the 12.5% of the variance in students' attitudes toward mathematics could be explained by the interaction of treatment and style of categorisation. This study showed that the field independent students in the FRS and TAI groups displayed more positive attitudes toward mathematics than their field dependent counterparts whereas the field dependent students in the TM group showed more positive attitudes toward mathematics than their field independent counterparts. This finding did not agree with the finding of Peklaj (2003) in which the field dependent students benefited most from cooperative learning. However, both the field independent and dependent students may benefit more from learner-centred instructions than the teacher-centred instructions (e.g. CGS) because learner-centred instructions promote meaningful learning in carefully structured interaction with teaching social skills (e.g. TAI) necessary for learning in groups and cognitive skills (e.g. FRS) that are anchored on previously learnt skills. In essence, the personal variable of style of categorization does interact with instruction to produce result. Thus, the treatment conditions were style of categorization sensitive on attitudes toward mathematics.

The significant interaction effect of gender and style of categorization recorded in this study showed that male and female students with different styles of categorization responded differently to attitudes toward mathematics and that the 1.4% of the variance in students' attitudes toward mathematics could be explained by the interaction of gender and style of categorisation. This result indicated that male students who were field independent had stronger attitudes toward mathematics than male field dependent students whereas female students who were field dependent had stronger attitudes toward mathematics than female field independent students. Thus, it could be said that the gender variable was style of categorisation sensitive on attitudes toward mathematics.

The significant three-way interaction effect of treatment, gender, and style of categorization on students' attitudes toward mathematics is at variance with previous studies (Awofala & Nneji, 2012; Awofala, Balogun & Olagunju, 2011; Awolola, 2011) on achievement. This result revealed that the treatment, gender and style of categorization did mutually influence attitudes toward mathematics to produce a joint effect and that the 3.4% of the variance in students' attitudes toward mathematics could be explained by the interaction of treatment, gender, and style of categorisation. The significant three-way interaction effect is explainable in that the interaction of two of the variables did change at different levels of the third variable. Thus, attitudes of students with different gender and different style of categorization tended to be sensitive to the instructional strategies employed with regards to whether the students are male or female or whether they exhibit field dependence or field independence style of categorization.

The findings of the study revealed that the strategy of framing and team assisted individualized instruction were effective methods of learning and improving students' attitudes toward mathematics. They had the potentials of not only improving students' achievement in mathematics (Awofala & Nneji, 2012) but also attitudes toward mathematics. It is therefore recommended that these strategies be put to use in the teaching and learning of mathematics and teachers of mathematics should endeavour to match teaching strategies with the manner in which students receive and process information. The non-significant interaction effect of treatment and gender recorded in this study implied that framing and team assisted individualized strategies could be used to advance learning and close the gap of gender disparity in the learning of mathematics. These strategies could be used as a basis for individualizing instruction for both male and female students.

Currently in Nigeria, the newly developed basic education and senior secondary mathematics curricula are being pilot-tested in a nation-wide experiment with the hope that major stakeholders in the education industry and mathematics teachers other than those who participated in the development process, will articulate their positions based on empirical observations of the missing elements in the curricula; collate and forward them to the NERDC for incorporation during the planned review. It is pertinent to note that the two mathematics curricula do not take into account Framing and TAI as teaching strategies that can be used to promote meaningful learning and advance students' attitudes toward mathematics. The NERDC saddled with the sole responsibility of developing the curricula for both primary and secondary education in the country is now enjoined to infuse these strategies of teaching and learning in its review of the school curricula. As shown in this study, these strategies could be used to improve students' attitudes toward the most dreadful school subject- mathematics. Attaining this will not only correct the impasse about mathematics as a difficult and anxiety inducing school subject but make the mathematics curricula and its teaching NEEDS driven to achieving the critical goals of MDG and EFA. The senior secondary school mathematics teachers should also consider the option of engaging their students with these strategies in learning mathematics since they proved better than the traditional method in promoting attitudes toward mathematics.

One limitation of this study is that it did not take into consideration the main effect of treatment (FRS, TAI & CGS) and moderating effects of style of categorization and gender on the individual dimension of attitudes toward mathematics. So, it is pretty difficult to isolate the effect of each treatment condition on each dimension of attitudes toward mathematics. Mere investigating the relation between instructional strategies and total attitudinal score in mathematics as done in the present study might obscure some salient information which may be useful in advancing appropriate intervention. This should be considered a fruitful area of further research which may lend itself to the adoption of more powerful statistic of multivariate analysis of covariance (MANCOVA).

References

[1] Abakpa, B. O. & Iji, C. O. (2011). Effect of Mastery Learning Approach on Senior Secondary Students' Achievement in Geometry. *Journal of the Science Teachers' Association of Nigeria,* 46(1), 165-176.

[2] Abiam, P. O. & Odok, J. K. (2006). Factors in Students' Achievement in Different Branches of Secondary School Mathematics. *Journal of Education and Technology*, 1(1)*,* 161-168.

[3] Adegoke, B. A. (2011). Effect of Indirect Teacher Influence on Dependent-prone Students' Learning Outcomes in Secondary School Mathematics. *Electronic Journal of Research in Educational Psychology,* 9(1)*,* 283-308.

[4] Agommuoh, P. C. & Nzewi, U. .M. (2003). Effects of Videotaped Instruction on Secondary School Students' Achievement in Physics. *Journal of the Science Teachers' Association of Nigeria* 38(1&2), 88-93.

[5] Aiyelaagbe, G. O. (1998). *Audio, Visual and Audio-visual based Self-learning Packages and Adult Learners' Performance in Basic Literacy Skills*. Unpublished Ph.D Thesis. University of Ibadan,.

[6] Ajiboye, J. O. A. (1996).*Self-Learning Programme, the Modified Lecture Method and Students' Cognitive and Affective Outcomes in Some population Education Concepts*. Unpublished Ph.D Thesis. University of Ibadan,

[7] Akay, H. & Boz, N (2010). The Effect of Problem Posing Oriented Analyses-II Course on the Attitudes toward Mathematics and Mathematics Self-Efficacy of Elementary Prospective Mathematics Teachers. *Australian Journal of Teacher Education,* 35*,* 60-75.

[8] Akinsola, M. K. & Awofala, A. O. A. (2009). Effect of Personalization of Instruction on Students' Achievement and Self-efficacy in Mathematics Word Problems. *International Journal of Mathematical Education in Science and Technology*, 40(3), 389-404.

[9] Akinsola, M. K. & Igwe, I. O. (2002). The relative effect of metacognitive strategy of framing on students' achievement in selected difficult chemistry topics. *Journal of the Science Teachers Association of Nigeria,* 37(2), 20-28.

[10] Akinsola, M. K. & Tella, A. (2003). Effectiveness of individualistic and cooperative teaching strategies in learning geometry and problem solving in Mathematics among junior secondary schools in Nigeria. *Personality Study and Group Behaviour,* 23, 95-105.

[11] Alaiyemola, F. F. (1990). The Effects of Metacognitive Strategy on the Anxiety Level of Students' in Science Class. *International Journal of Science Education*, 12(1), 95-96.

[12] Ale, S. O. (1989). School Mathematics in the 1990s: Some Major Problems for the Developing Countries. *International Journal of Mathematical Education in Science and Technology,* 20(5), 655-659.

[13] Arigbabu, A. A. & Mji, A. (2004). Is gender a factor on mathematics performance among Nigerian preservice teachers? *Sex Roles: A Journal of Research,* 51(II), 749-753

[14] Awofala, A. O. A, Balogun, T. A, & Olagunju, M. A. (2011). Effects of three modes of personalization on students' achievement in mathematics word problems in Nigeria. *International Journal of Mathematics Teaching and Learning,* Available at http://www.cimt.plymouth.ac.uk/journal/awofala.pdf.

[15] Awofala, A.O.A. (2012) An Analysis of the new 9-year basic Education mathematics Curriculum in Nigeria. *Acta Didactica Naponcensia,* 5(1), 17-27

[16] Awofala, A. O. A. (2011a). Effect of Concept Mapping Strategy on Students' Achievement in Junior Secondary School Mathematics. *International Journal of Mathematics Trends and Technology, 2*(2)*,* 11-16.

[17] Awofala, A. O. A. (2011b). Is Gender a Factor in Mathematics Performance among Nigerian Senior Secondary Students with Varying School Organization and Location? *International Journal of Mathematics Trends and Technology*, 2(3), 17-21.

[18] Awofala, A. O. A. (2010). *Impact of Personalised instruction on Senior Secondary School Learning Outcomes in Mathematics word problems.* Unpublished Ph.D Thesis. University of Ibadan.

[19] Awofala, A. O. A. (2007). Women and the learning of mathematics. *African Journal of Historical Sciences*, 3(1), 195-213.

[20] Awofala, A.O.A (2002). *Concept Mapping, Problems Solving Paradigms and Achievement in Secondary School Mathematics* (Unpublished M.Ed Project) University of Ibadan, Ibadan.

[21] Awofala, A. O. A. & Awolola, S. A. (2011) Coping with New Mathematics Teacher's Beliefs in a Conflicting Milieu of Curriculum Transform. In O.S. Abonyi (Ed.) *Proceedings of 52nd Annual Conference of the Science Teachers Association of Nigeria on Reforms in Science, Technology, Engineering and Mathematics* (pp.309-315) HEBN Publishers Plc.

[22] Awofala, A. O. A. Fatade, A. O., & Ola-Oluwa, S. A. (2012). Achievement in Cooperative versus Individualistic Goal-Structured Junior Secondary School Mathematics Classrooms in Nigeria, *International Journal of Mathematics Trends and Technology,* 3(1)*,* 7-12.

[23] Awofala, A. O. A. & Nneji, L. M. (2012). Effect of framing and Team Assisted Individualised Instructional Strategies on Students' Achievement in Mathematics. *Journal of the Science Teachers Association of Nigeria,* 43(3), 20-28.

[24] Awolola, S. A. (2011). Effect of brain-based learning strategy on students' achievement in senior secondary school mathematics in Oyo State, Nigeria. *Cypriot Journal of Educational Sciences*, 2, 91-106.

[25] Biggs, J. (1988). The role of metacognition in enhancing learning. *Australian Journal of Education*, 32(2), 127-138.

[26] Bloom, B. S. (1981). *All Our Children Learning*: New York, NY: McGraw-Hill.

[27] Brown, S. I., & Walter, M. I. (1993). *Problem posing: reflection and applications*. Hillsdale, NJ: Erlbaum.

[28] Casey, M. B., Nuttall, R. L., & Pezaris, E. (2001). Spatial-mechanical reasoning skills versus mathematical self-confidence as mediators of gender differences on mathematics subtests using cross-national gender-based items. *Journal for Research in Mathematics Education*, 32(1), 28-57.

[29] Costello, J. (1991), *Teaching and Learning Mathematics*. pp. 11-16. London: Routledge.

[30] Daskalogianni, K. & Simpson, A. (2000). Towards a definition of attitude: the relationship between the affective and the cognitive in pre-university students. *Proceedings of PME 24*, 217-224, Hiroshima, Japan.

[31] Dreher, M. J. & Singer, H. (1980). Story Grammar Instruction Unnecessary for Intermediate Grade Students, *The Reading Teacher,* 35, 176-179.

[32] Ekwere, O. J. T. (1998). *Effects of Metacognitive Instructional Strategies on Students' Concept Attainment in, and Attitude towards Chemistry in Ibadan Municipality*. Unpublished Ph.D Thesis. University of Ibadan.

[33] English, L. D. (1997). The Development of Fifth grade Children's Problem Posing Abilities. *Educational Studies in Mathematics*, 34, 183–217.

[34] Erinosho, S. Y. (1997). *Female Participation in Science: An Analysis of Secondary School Science Curriculum Materials in Nigeria*. Abridged Research Report No. 2.

[35] Ethington, C. A. (1992), Gender differences in a psychological model of mathematics achievement. *Journal for Research in Mathematics Education*, 23(2), pp. 166-181.

[36] Farooq, M. S. & Shah, S. Z. U. (2008). Students' attitude towards mathematics. *Pakistan Economic and Social Review* 46(1), 75-83.

[37] Fatade, A. O., Nneji, L. M., Awofala, A. O. A., & Awofala, A. A. (2012). Mode of Entry and Gender as Determinants of Nigerian Pre-service Teachers' Performance in Degree Mathematics and Science Courses, *International Journal of Mathematics Trends and Technology,* 3(3), 103-109.

[38] Fennema, E. & Sherman, J. (1977), Sex-related differences in mathematics achievement, spatial visualization and affective factors. *American Educational Research Journal*, 14, 51-71.

[39] Fennema, E & Sherman, J. A. (1976). Fennema-Sherman mathematics attitude scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. *Journal for Research in Mathematics Education*, 7, 324-326.

[40] Fullarton, S. (1993), *Confidence in Mathematics: The Effects of Gender*. Geelong: Deakin University Press.

[41] Georgewill, J. W. (1990). Causes of Poor Achievement in West Africa School Certificate Mathematics Examination in River State Secondary School, Nigeria. *International Journal of Mathematical Education in Science and Technology,* 21(3), 379-385.

[42] Haladyna, T., Shaughnessy, J., & Shaughnessy, M. (1983). A causal analysis of attitude toward Mathematics. *Journal for Research in Mathematics Education*, 14, 19-29.

[43] Hannula, M. (2002). Attitude toward mathematics: emotions, expectations and values. *Educational Studies in Mathematics*, 49, 25-46.

[44] Hart, L. (1989). Describing the Affective Domain: Saying What We Mean. In Mc Leod & Adams (Eds.). *Affect and Mathematical Problem Solving* (pp.37-45). New York: Springer Verlag.

[45] Hyde, J. S., Fennema, E., Ryan, M., Frost, L. A., & Hopp, C. (1990). Gender comparisons of mathematics attitudes and affect: A meta-analysis. *Psychology of Women Quarterly*, 14(3), 299-324.

[46] Ifamuyiwa, S. A. & Akinsola, M. K. (2008). Improving Senior Secondary School Students' Attitude towards Mathematics. *International Journal of Mathematical Education in Science and Technology*, 39(5), 569-585.

[47] Ige, T. A. (2001). Concept of Mapping and Problem-Solving Teaching Strategies as Determinants of Achievement in Secondary School Ecology. *Ibadan Journal of Educational Studies* 1(1), 290-301.

[48] Imoko, I. B. & Agwagah, U. N. V. (2006). Improving Students' interest in Mathematics through the Concept Mapping Technique: A Focus on Gender. *Journal of Research in Curriculum and Teaching* 1(1), 30-38.

[49] Jonasen, D. H. & Grabowski, B. L. (1993). *Handbook of Individual Differences, Learning and Instruction*. Hillsdale, NJ: Lawrence Erlbaum.

[50] Joyce, B., & Weil, M. (1980). *Models of Teaching*. New Jersey; NJ: Prentice-Hall.

[51] Kadijevich, D. (2006). Developing trustworthy TIMSS background measures: A case study on mathematics attitude. *The Teaching of Mathematics*, 9, 41-51.

[52] Leder, G. (1985). Measurement of attitude to mathematics. *For the Learning of Mathematics*, 34, 18- 21.

[53] Leder, G. C. (1982), Mathematics achievement and fear of success. *Journal for Research in Mathematics Education*, 13(2), 124-135.

[54] Leonard, W. H. (1989). A Comparison of Spatial Learning Strategies with Interactive Video Disk and Conventional Laborator.. *Science Education,* 21, 97-112.

[55] Levin, D. (1985). *Improving Student Achievement through Mastery Learning Programs.* San Francisco: Jossey-Bass

[56] Levin, J. R. Alglin, F. E. & Carrey, B. E. (1987). Four Cognitive Principles of Learning Strategy Instruction*. Educational Psychology,* 21, 3-18.

[57] Ma, X. & Kishor, N. (1997). Assessing the relationship between attitude toward mathematics and achievement in mathematics: A meta-analysis. *Journal for Research in Mathematics Education*, 28(1), 27-47.

[58] McAleese, R. (1985). Some Problems of Knowledge Presentation in an Authority Environment: Exteriorization, Anomalous State Metacognition Self-Confrontation. *Programmed Learning and Educational Technology*, 22, 299-306.

[59] McLeod, D. (1992). Research on affect in mathematics education: a reconceptualization. In D.Grows (Ed.), *Handbook of Research on Mathematics Teaching and Learning* (pp.575-596). New York: McMillan Publishing Company.

[60] Minsky, M. (1975).A Framework for Presenting Knowledge. In P.H Winston (Ed). *The Psychology of Computer Vision*. New York.: Mc Graw-Hill.

[61] Nicolaou, A. A., & Philippou, G. N. (2004). Efficacy Beliefs, Ability in Problem Posing, and Mathematics Achievement, *Proceedings of the 3rd International Biennial SELF Research Conference Berlin, Self-Concept, Motivation and Identity: Where to from here?* 4 – 7 July, 2004.

[62] Obioma, G. O. (2005). Emerging issues in Mathematics Education in Nigeria with Emphasis n the Strategies for Effective Teaching and Learning of Word Problem and Algebraic Expressions. *Journal of Issues on Mathematics* 8(1), 1-8.

[63] Obioma, G. O. & Adibe, M. O. (1987). Effects of Group Instructional Techniques on Mathematics Achievement of Junior Secondary School Slow Learners. *Journal of the Science Teachers' Association of Nigeria*, 25(2), 92-96.

[64] Odogwu, H. N. (2002). Female Students' Perception and Attitude to Mathematics: A Bane to their S.M.T Education. ABACUS. *The Journal of the Mathematics Association of Nigeria,* 27(1), 19-29.

[65] Ogunleye, B. O. & Babajide, V. F. T. (2011). Commitment to Science and Gender as determinants of Students' Achievement and Practical Skills in Physics. *Journal of the Science Teachers' Association of Nigeria,* 46(1), 125-135.

[66] Ogunneye, W. (2003). Students' Understanding of the Concept of Gradient in Physics. A Case Study of Physics Students from Tai Solarin College of Education, Ijebu-Ode. *Journal of the Science Teachers' Association of Nigeria,* 38(1&2), 100-106.

[67] Ojo, M. O. (1992). The Differential Effectiveness of Cooperative, Competitive and Individualistic Classroom Instruction Patterns on Students' Chemical Problem Solving Skills. *The Nigerian Teacher Today,* 1(2), 121-129.

[68] Ok'wo, F. A. & Otubar, S. (2007). Influence of Gender and Cognitive Styles on Students' Achievement in Physics Essay Test. *Journal of the Science Teachers' Association of Nigeria,* 42(1&2), 94-101.

[69] Okebukola, P. A. O. (1984). Tackling the Problem of Large Classes in Biology. An Investigation into the Effect of Cooperative Learning Technique. *Journal of the Science Teachers' Association of Nigeria*, 22(2), 73-77.

[70] Okebukola, P. A. O. (1995). Relative Effectiveness of Cooperative and Competitive and Interaction Technique in Strengthening Students' Performance in Science Classes. *Journal of Science Education,* 69, 501-509.

[71] Okebukola, P. A. O. & Ogunniyi, M. B. (1984). Cooperative, Competitive and Individualistic Science interaction pattern: Effects on Students' Skills. *Journal of Research in Science Teaching*, 21(9), 875-884.

[72] Oltman, P. K. Raskin, E. & Witkin, H. A. (1982). Group Embedded Figures Test. Palo Alto,CA: Consulting Psychologist Press.

[73] Orhun, N. (2007). An investigation into the mathematics achievement and attitude towards mathematics with respect to learning style according to gender. *International Journal of Mathematical Education in Science and Technology*, 38, 321–333

[74] Orukotan, A. F. (1999). *Effects Metacognitive Instructional Strategies of Framing and Rehearsal on Students Learning Outcomes in Secondary School Genetics*. Unpublished Ph.D Thesis. University of Ibadan,.

[75] Peklaj, C. (2003). Gender, Abilities, Cognitive Style and Students' Achievement in Cooperative Learning. *Pscholosksa Obzorja/ Horizons of Psychology*, 12, 9-22.

[76] Riding, R. I & Al-Salih, N. (2000). Cognitive Style and Motor Skill and Sports Performance. *Educational Studies* 26, 19-32.

[77] Sayers, R. (1994). Gender differences in mathematics education in Zambia. *Educational Studies in Mathematics*, 26(4), 389-403.

[78] Schiefele, U. & Csikszentmihalyi, M. (1995), Motivation and ability as factors in mathematics experience and achievement. *Journal for research in mathematics education*, 26(2), 163-181.

[79] Sherman, J. A. (1982), Mathematics the critical filter: A look at some residues. *Psychology of Women Quarterly*, 6(4), 428-444.

[80] Silver, E. A. (1994). On mathematical problem posing. *For the Learning of Mathematics*, 14, 19–28.

[81] Silver, E. A., Mamona-Downs, J., Leung, S. S. & Kenney, A. P. (1996). Posing Mathematical Problems: An exploratory study. *Journal for Research in Mathematics Education*, 27, 293–309.

[82] Slavin, R. (1980). Using Student Team Learning. Baltimore, MD: John Hopkins University.

[83] Slavin, R. *(*1982). Cooperative Learning: Student Teams. *Washington, DC: National Education Association.*

[84] Slavin, R. (1983a). When Does Cooperative Learning Increase Student Achievement? *Psychological Bulletin*, 93, 429-445.

[85] Slavin, R. (1983b).Cooperative Learning New York: Longman.

[86] Slavin, R. (1984). Learning to Cooperate, Cooperating to Learn: Basic Concepts. In R. Slavin; S., Sharan; S., Kagan; R., Lazarowitz; C., Webb and R. Schmuck (Eds), Learning to Cooperate, Cooperating to Learn. New York: Plenum.

[87] Slavin, R. (1985). Some Group Instruction. *The International Encyclopedia of Education* 8, 4596-4601.

[88] Slavin, R. E. (1995). *Cooperative Learning: Theory, Research and Practice*. Allyn and Bacon.

[89] Slavin, R. E. &. Karweit, N. L (1985). Effects of Whole Class, Ability Grouped, and Individual Instruction on Mathematics Achievement. *American Educational Research Journal* 22(3), 351-367.

[90] Tapia, M. & Marsh II, G. E. (2004). An instrument to measure mathematics attitudes. *Academic Exchange Quarterly, 8,* 130-143.

[91] Van Pattern, J. Chao, C. & Reigeluth, C. M. (1986). A Review of Strategies for Sequencing and Synthesizing Instruction. *Review of Educational Research,* 56, 437 –471.

[92] Vermeer, H., Boekaerts, M., & Seegers, G. (2000). Motivational and gender differences: Sixthgrade students' mathematical problem-solving behavior. *Journal of Educational Psychology*, 92(2), 308-315.

[93] Welch, W.W. (1985). Secondary Analysis and National Assessment in Science in United States of America. In B. J. Fraser and K. C. Tobin (Eds) *Secondary Analysis and Large Scale Assessment*, Australia: Institute of Technology.

[94] Willis, S. (1995), Gender justice and the mathematics curriculum: Four perspectives. In: L. Parker, L. Rennie and B. Fraser (eds.), *Gender, Science and Mathematics Shortening the Shadow* (pp. 41-51). Dordecht: Kluwer.

[95] Witkin, H. A. & Goodenough, D. R. (1981). *Cognitive Styles: Essence and Origins*, New York NY: International University Press.

[96] Witkin, H. A., Moore, C., Goodenough, D. R. & Cox, P. (1977). Field-dependent and Field-independent Cognitive Styles and their educational implications. *Review of Educational Research*, 47, 1-64.

[97] Zan, R., & Di Martino, P. (2007). Attitudes towards mathematics: Overcoming positive/negative dichotomy. *The Montana Mathematics Enthusiasts Monograph,* 3, 157-168.

Authors

Adeneye O. A. Awofala, Department of Science and Technology Education, Faculty of Education, University of Lagos, Yaba, (Nigeria), e-mail: awofalaaoa@yahoo.co.uk

Abayomi A. Arigbabu, Department of Mathematics, College of Science and Information Technology, Tai Solarin University of Education, Ijagun, (Nigeria), e-mail: arigbabuaa@yahoo.com

Awoyemi A. Awofala, Department of Biological Sciences, College of Science and Information Technology, Tai Solarin University of Education, Ijagun, (Nigeria), e-mail: a.a.awofala@gmail.com