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Abstract

The study which is an excerpt of an ongoing research that examined the effects of jigsaw-iv instructional strategy on the attitude of students towards co-ordinate geometry. The pre-post-tests non-equivalent quasi-experimental research design was adopted, where the experimental (jigsaw) and control groups received both pre-test and post-test, but the control group was conventionally exposed the same concept. The purposively sampled respondents were selected from public senior secondary school II in Education District V. A self-developed questionnaire on Students' Attitude towards Co-ordinate Geometry (SATC) with Pearson R coefficient of 0.74 was employed. Mean, standard deviation and bar-chart were used to answer the two research questions. The three null hypotheses were tested using the Analysis of Co-Variance (ANCOVA) at 0.05 level of significance. It revealed significant effects of jigsaw-iv strategy on students' attitude towards coordinate geometry but no significant effects of gender. However, there was significant interaction effect of treatment and gender in attitude towards coordinate geometry lessons. The study recommended that Mathematics teachers should be mandated by curriculum developers to make appropriate use of Jigsaw-iv strategy in teaching basic concepts in Mathematics; and teachers should endeavour not to be gender biased with respect to the use of collaborative instructional strategies such as Jigsaw-iv.

Introduction

There is a lacuna between students' attitude towards coordinate geometry and teachers' choice of instructional approach. Some mathematics teachers believe that students vary in boldness towards geometric topics (Mohamed et al, 2013), because they are under the umbrellas of teachers with diversified backgrounds and exposure to instructional modes. Still, others believe that students' negative inclination is due to high reliance on colleagues during examination (Timayi, Bolaji & Kajuru, 2015), yet majority assumed that students' negative disposition is a product of mismatch of teachers' pedagogies and mathematical content (Chagwiza et al, 2013). However, it is pertinent to note that some teachers are still very unfamiliar with contemporary interactive strategies, amidst those battling with right choice of strategies. Since the society at large accepts the impression that students are poor in attitude due to teachers' inadequate choice of instructional strategy (Mohamed et al, 2013), parents have censured mathematics teachers for students' incapability to continuously exhibit satisfactory level of behavior and mathematical skills (Das & Das, 2013).

Although, there is no best instructional strategy to teach a concept (Royal Society & Joint Mathematical Council working group, 2001), but it is counter-productive to apply strategies indiscriminately without considering extraneously potent factors: content, age and students' abilities. For instance, on one hand, Mohamed (2010) found that 37.5% of the teachers investigated held that lack of interactive instructional strategies played a significant role on students' attitude towards coordinate geometry, while Mbacho (2013) included students' ability, age, textbooks, teachers' qualification, gender stereotypes, lack of role models, class size, peer preasure, school type and location as factors attributed to students' appalling attitude. However, Tata, Abba and Abdullahi (2014); Lawan and Olaji (2019) opined that anxiety, teachers' qualifications, poor teaching strategies, inadequate instructional materials, and overcrowded classes. Therefore, it is not out of place for teachers to adopt techniques that foster class interaction, student-students question and answer sections irrespective of learners' ability levels. Granted, all students are not equal in requisite skills and ability to handle mathematical challenges. As a matter of fact, most senior secondary schools in Lagos State are multi-cultural and consist of classes with mixed ability students. So, there is need for students with high ability to actively ionize with the average or low ability learners by adopting the jigsaw collaborative learning strategy.

Alshammari (2015) pronounced those students are more positive in attitude when jigsaw cooperative learning strategy is adequately substituted for conventional approach. It affirmed that the traditional but individualized approach is not an effective means of equipping students with enough resources to broaden their horizon of understanding, whereas the jigsaw strategy is preferable to conventional approaches because it is both individualized and interactive in nature (Candeias et al, 2012). The jigsaw approach transcends individualization and peer-tutoring to groups of 4-6 participants per group. Moreover, jigsaw approach has proved to be useful in equipping students with the ability to develop deeper understanding of subject matter (Molly, Dingel & Aminul, 2014). It fosters interaction within groups, promotes individual responsibility for learning, raises meta-cognitive awareness, increase cooperation, develop social skills, motivation, and elongate knowledge retention (Davidson & Major, 2014). As if it is not enough, Dallmer (2007) opined that jigsaw atmosphere motivates students to challenge their colleagues, triggers their desire to spend extra time to decode and digest useful learning contents that were not initially well understood. In fact, the students benefit from skills gained from their colleagues through consultative learning environment.

The study adopted the Aptitude Treatment Interaction (ATI) theory (Cronbach & Snow, 1977), which is interested in how some people are attracted to certain instructional strategies by their natural abilities. It opined that maximum learning occurs when the teachers’ strategy matches learners’ natural abilities. It implies that mathematics teachers can predict maximum learners’ attitude if intervention balances with class activities. In essence, ATI supports social learning processes through active participation and personal experience. In view of this, the study believes that by exposing students to jigsaw social environment they would be provided with ample opportunity for observation, initiation, and positive attitudes towards coordinate geometry s a concept. This theory relates with the Zone of Proximal Development (ZPD) as propounded by Vygotsky (1978), which states that no matter how knowledgeable an individual is, there is always a gap to be filled. This gap emerged as a result of three levels of task development: 1. task that an individual can perform without help, 2. task that can be performed with help and 3 task that cannot be performed by an individual. This gap is an area within which problems are too difficult to solve alone but not too hard to solve with the help of adults or more competent persons (Kearsley, 2005). Hence, the theory links acquired knowledge to that which is unknown or yet to be learnt. In order to develop the Z.P.D., learners need to actively and cooperatively interact socially with a more knowledgeable individual or capable peers (Subban, 2006). Admittedly, a student can only progress to the Z.P.D., and consequently to independent learning if he or she is first guided by an expert (Kearsley, 2005). The study hereby opined that upward development of students’ aptitude could metamorphosed into better attitude towards coordinate geometry with the application of Jigsaw strategy, which is the kind of treatment that require active listening, thinking, questioning, participation and interaction (Akudo, 2013). At this juncture, it is pertinent to underscore the rationale behind the intervention by contrasting conventional approach with the concepts of jigsaw strategy.

Conventional approach was seen by Ajai (2012) as a teacher centred way of presenting a lesson package to a large group of audience, or an approach that enables the teacher to pass information simultaneously to a faction of learners without giving opportunity for learners-learners interaction. It can be said that mathematics knowledge gained through conventional approach is does not stand the tst of time (Ullah, Tabassum & Kaleem, 2018). This is because no matter how well-crafted and captivating a conventional presentation may be, the presenter could only cover much course content or converge large evidence from a wide variety of sources, without given due attention to the extent to which students assimilate, meditate on and retain what is taught. However, in this study, conventional strategy was seen as a teaching style used by the teacher to simultaneously disseminate individualized instruction before a large group of learners (Eison, 2010). Due to the existence of large classes in most schools, teachers are often handicaped in approach to teach students of colours based on individual needs without leaving any child behind. In this scenario, jigsaw-iv could be an ideal strategy to overcome the dilema faced by teachers and thus enable them to fill students’ needs without any extra financial resources. Jigsaw-iv cooperative strategy is opposed to conventional approach because it allows informaton to be diseminated inclusively and unselfishly (Timayi, Bolaji & Kajuru, 2015).

The Jigsaw strategy is a cooperative and collaborative learning strategy that can reduce racial conflict among students, stimulates better learning, increases students’ motivation, and promotes increases enjoyment of the learning experience (Aronson, 2008). It was developed by Elliot-Aronson’ team in 1971 with the intention of reducing racial conflict, enhancing positive educational outcomes, and encouraging cooperative learning environment among students (Timayi, Bolaji & Kajuru, 2015). In contrast to the above year of invention, Hedeen (2003); Simsek (2007); Olaoye (2009); Maden (2010); Timayi, Bolaji and Kajuru (2015); and Turkmen and Buyukaltay (2015) reported that jigsaw was invented in 1978 by Aronson, Blaney, Stephen, Sikas and Snapp while trying to launch ways of rescuing a volatile situation among students, at the University of Texas as well as University of California. The study believes that jigsaw strategy must have been developed in 1971 but formerly published in an article in 1978. However, after detecting teachers' inability to arrest an existing hostile situation, Aronson arranged the culturally and racially diverse students into cooperative and collaborative groups. The racially segregated and incompatible group of 26-33 students were divided into competency groups of 4-6 students, to research individually in home groups and then break off to work with the experts from other groups.

Apart from helping students to develop skills and expertise needed for effective participation in group activities, the technique motivates them to work in small groups (Lestik & Plous, 2012). It knows no boundary, as it could be used to apportion varieties of learning materials and content areas to match any class size and different levels of students' readiness (Penn-State Institute, 2007; Gregory, 2013); facilitate learning through shared responsibility (Perkins & Saris, 2001); and help students to focus their attention on a given task.

Barbara (2012) supported that the strategy divides a heterogeneous set of students into multiple home groups of 4-7 students each. Each home group receives a slightly differentiated but well-defined task from the teacher with firm instructions on how each member cooperates to achieve a common goal as a team. Each team collaborates on the task, engages in inter and intrapersonal activities that allow them to process information and interact with a variety of class members to gain greater understanding of mathematical skills. The teachers make themselves readily accessible to address any challenges as the various groups work on their material and develop expertise in the designated area. Then the home groups are re-arranged by the instructor to create new groups of experts that comprises one member from each of the home groups. Within the new groups each student has designated expertise and is responsible for teaching the skills learned while in the home group as well as learning the skills from the other groups. Jigsaw activities offer chances for elaborative rehearsal and use of well-organized thought through interchange of skills (Gregory, 2013; Adil et al, 2020). By closely monitoring the contributions of each student during group activities to ensure that tasks are well managed; asking groups to stop and think about how everyone is doing and ensuring that everyone's voice is heard; teachers are able to obtain how much information the students already know about the topic, ask appropriate questions, if necessary, reframe and tailor their explanation effectively until it is clear to all group members. Jigsaw strategy would be seen in this study as a multi-stage group approach to learning, which involves splitting a whole concept into 4-6 chunks or indivisible units.

Group members are expected to work together as a team to achieve a common objective, as students depend on one another. During cooperative collaborative exercises, no student can completely succeed independent on others. Rather everybody works as a team-player and value one some another as key contributors to their individual and common success. In addition, Penn-State (2007) forwarded that the success of each group depends largely on the participation and contribution of everyone in completing their assigned task. This means that the involvement of each student in the activity increases effectively as it places great emphasis on cooperation and mutual tasks among groups.

Timayi (2016) described Jigsaw IV as a cooperative learning strategy that assigns students to a heterogeneous Home Groups (HG) based on the number of items in the content to be learnt. Members in the HGs with the same code are re-grouped into different Expert Groups (EG) where they learn only a part of the entire material content. They return to their home group to teach members and take quizzes as prepared by the teacher based on the material. Finally, the teacher re-teaches any material which was misunderstood after the individual assessment process. It has the features of Jigsaw-I, II and III but it includes introduction of materials, quizzes, and re-teaching of assigned material after evaluation (Samuel, 2018; Janson, Somsook & Coll, 2008). Here, the topics are the same at home group but differentiated at expert groups. Each student is assigned to a specific topic but unlike Jigsaw-II students are not exposed to all the topics at home groups. As highlighted by Maden (2010) and Gonzale (2015), the implementation phases of Jigsaw-IV include: (i) formation of groups of 4 to 7 heterogeneous students; (ii) splitting the learning materials into smaller parts in in line with the number of students and assigning each part to one student, and (iii) generating expert groups by bringing students of like topics together. It presents opportunity for participants to return from expert groups to their home groups to further discuss new discovery or correct any errors committed while in home groups.

The benefits of applying the jigsaw strategy are increasingly overwhelming. i. with the approach, the teacher can re-structure class activities to suit their objectives by using timely prompts and providing the way out where necessary; ii. it motivates students to act as both tutor and tutee during the exercise; iii. it helps students to develop spirit of expertise; iv. it eliminates shyness; v. it facilitates division of labour; vi. it promotes interactive spirit; vii. it fosters cooperation among peers; viii. it is productive when used for consolidation exercises ix. it eliminates spirit of ethnicity or nepotism (Aronson & Patnoe, 2011). It means that teachers could use the strategy to motivate learners towards positive change in attitude towards coordinate geometry.

Technically, attitudes are positive or negative evaluative statements connected to a person' outward disposition (Kpolovie, Joe & Okoto, 2014). According to Sani (2017) attitude is a learned predisposition of an individual to respond positively or negatively to a given situation, concept, or another person. It covers the i. affective components e.g., feelings, emotions towards an object; ii. behavioral components e.g., past, and future activities towards an object; and iii. cognitive components e.g., thoughts and beliefs about an object. By implication, an individual would likely develop positive attitude towards an object whenever these three components are positive. They reflect determined outlook of an individual to react and behave in a certain way towards people and situations. People form opinions about a person' attitude when they see the outward reflection of the inner mind. Attitudes are to some extent dynamic in nature and in time can be re-molded into a different type (Kalder & Lesiki, 2011). Based on attitude, students respond differently when exposed to different learning situations. For example, a student who learns by cheerfully interacting with others in classes may not react cheerfully when the class is devoid of discussion. It doesn't mean that student in conventional classes is not cheerful, but the learning atmosphere is not conducive enough for effective learning to take place.

In most cases, students are disposed to form their attitude around the above traits based on knowledge, and experience, assumptions, beliefs, how they think, do often and feel. Kalder and Lesiki (2011) described a series of latent class analyses used to classify students based on their responses to statements on attitudes towards coordinate geometry. The findimgs underscored participants with strong positive attitudes towards the subject areas. The report added that students across all ages were more ready to comprehend and master basic concepts in coordinate geometry. The strong relationship between positive attitudes towards coordinate geometry and academic success cannot be underestimated (Schenkel, 2009). In view of this outcome, it is important to itemize how or where positive attitudes towards coordinate geometry is developed.
Anderson (2007) found that there is a strong link between teachers' attitudes and their students' attitudes. Mathematics teachers who were positively influenced by their teachers, tend to believe that anyone with positive attitude could succeed in mathematics. It is therefore imperative that mathematics teachers demonstrate positive attitudes and allow their students to progress similarly. It will be counter-productive and quite unfortunate, for teachers with negative attitude and belief to transfer the same learning environment to their mathematics classroom practice (Bolhuis & Voeten, 2004). Kpolovie, Joe and Okoto (2014) conducted research to ascertain the magnitude of relationship of students' attitude towards learning and their academic achievement. There was a significant positive relationship between students' academic achievement and attitude. Therefore, attitude accounted for 21.60% of the variance in students' academic achievement. Thus, improvement in students' attitude towards learning could boost their achievement in coordinate geometry and mathematics at large. In view of this, mathematics teachers across all levels are expected to support students in developing positive attitudes towards acquisition of mathematical skills for better achievement.

While examining the effects of Jigsaw IV Cooperative Learning Strategy on students' attitude towards geometry, Timayi (2016) obtained a significant difference in attitude in favour of students exposed to the Jigsaw IV, but no significant difference was found with respect to gender in both treatment and control groups. On the contrary, Sengul and Katranci (2013) found no significant difference between the pre and post-test scores of students but reported significant difference in by gender in favor of the boys. Michelli (2013) investigated how attitudes of students' affect their academic achievement in coordinate geometry with respect to confidence and motivation. The results indicated a significant relationship between attitudes and achievement in coordinate geometry but found that males were more positive in attitude than females. Adejoh (2015) pointed out that gender is associated with numerous socially and culturally created characteristics, values, behaviours, and roles which different societies ascribe to males and females. In the same vein, Uwalaka (2013) saw gender as a social differentiation and cultural uniqueness between males and females and the attribution of certain the roles emanating from their differences.

Therefore, continuous failure by teachers to adopt interactive instructional strategies such as jigsaw in the classr ooms, could perpetuate students' negative attitude towards the subject for more decades, and might further lead to unacceptable level of achievement in mathematics (Candeias et al, 2012). Though, there is no doubt that mismatch of instructional strategies and teacher's subject matter has unconsciously produced crops of math-phobic students. In turn, phobia in mathematics has adversely affected their attitude. To the extent that mere reflection on teacher' traditional but less dynamic approach to teaching, usually prompt assumption that no matter how hard they try, they would never understand the topic. In lieu of such negative mind-set, many students have been discouraged from class attendance and some who manage to attend usually fall asleep or are distracted in class. There are students that dislike coordinate geometry simply because steps are not clearly understood. Untold number of them are afraid to express themselves during class activities, let alone make meaningful contribution to lessons, yet another category neither interact with their colleagues nor ask questions for clarification.

Consequently, partial understanding, anxiety and negative attitude are the attendant effects of poor pedagogic content knowledge. It is amazing that there is dearth of empirical literature on effects of jigsaw collaborative strategy on attitude towards geometry among senior secondary school students in Nigeria. The situation may worsen, and future mathematics education could collapse, if teachers' pedagogy continues to be at variance with content, learning styles, ability levels and average age of the learners.
Hence this quest has become very inevitable at this point, with the objective of investigating amidst several collaborative strategies, the effects of jigsaw strategy on attitude of students towards coordinate geometry, while putting gender under control. It is highly anticipated that the findings of this study would equip authors of mathematics textbooks and students with new insights on how best to match instructional strategies with content areas under consideration. Policy makers and curriculum developers might use the results as a guide in recommending appropriate learning strategy that would positively change learners' disposition.

Research Questions

The study was guided by the following research questions:

1. What are the attitudes of students towards coordinate geometry lessons when exposed to jigsaw instructional strategy?
2. What are the attitudes of students towards coordinate geometry lessons based on gender when exposed to jigsaw instructional strategy?

Research Hypotheses

The following null hypotheses were tested at 5% level of significance:

1. There is no significant main effect of jigsaw instructional strategy on attitude of students towards co-ordinate geometry lessons.
2. There is no significant main effect of gender on attitude of students exposed to co-ordinate geometry using jigsaw strategy.
3. There is no significant interaction effects of jigsaw and gender on students' attitude towards co-ordinate geometry.

Methodology

The pre-post-tests non-equivalent quasi-experimental research design was adopted, where the experimental (jigsaw) and control groups received both pre-test and post-test, but the control group was conventionally exposed the same concept. The target population consists of all senior secondary school II students in Lagos State, while the actual population was all the public senior secondary school II students in Education District V. The study purposively sampled a total of 89 science students from the two schools for the study. Base on the number of students in each class, the schools were purposively assigned to experimental and control groups. There were 30 participants in Jigsaw group (13 males and 17 females) and 59 in the modified conventional group (25 males and 34 females).

Instrument

The Questionnaire on Students' Attitude towards Co-ordinate Geometry (SATC) which was self-developed and consisting of parts A and B which seeks the opinions of students on their attitude towards co-ordinate geometry was employed with Pearson R coefficient of 0.74. Part A contains their demographic information on name and gender. Part B captured ten items that elicited their attitude toward coordinate geometry on five Likert scale type, corresponding to Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). These were rated as 5, 4, 3, 2 and 1 mark(s) respectively for positively worded items and 1, 2, 3, 4 and 5 marks respectively for negatively worded items (Kalder & Lesik, 2011).

Validating the instrument

The questionnaire was first shown to three senior secondary school 2 students outside the sample to detect difficult items, before it was presented to three Ph. D students in Mathematics education to further detect any possible ambiguity. It was later perused by three Lecturers before administration. Next, the researcher trained two research assistants collectively and individually on requisite skills needed to execute the lesson package. The SATC was pre-administered to the respondents in their intact classes before the treatment which lasted for five weeks. The students were post-tested with the same instrument after the exercise.

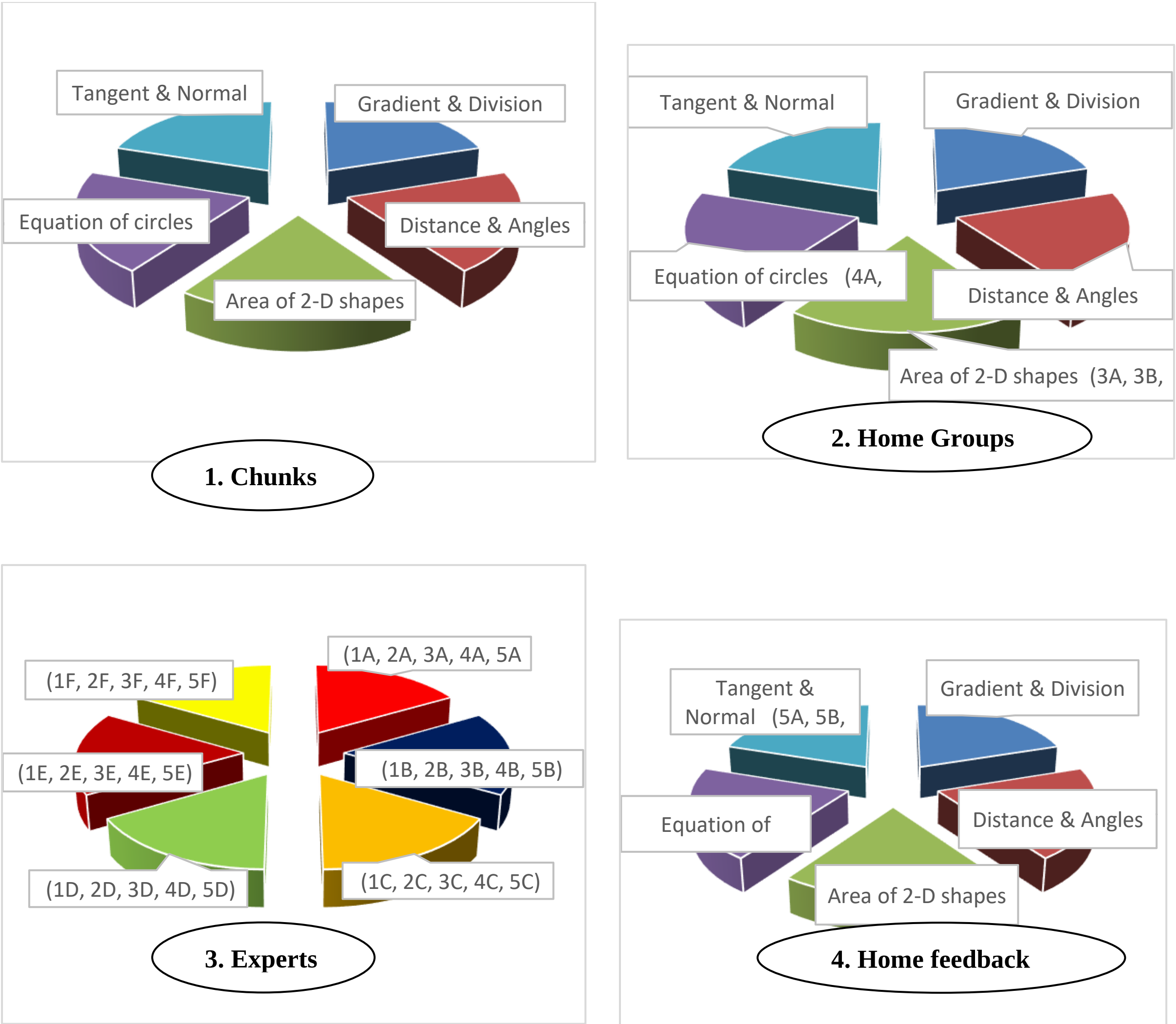

Fig 1: Implementing Jigsaw Instructional Strategy

The students were pre-informed by the research assistant that the Jigsaw-IV strategy would be used to teach coordinate geometry. The teacher then furnished the heterogeneous group of students with information on the approach. They were split into groups of 5-6 students and then the classroom was re-organized to accommodate group activities before SATC was administered to ascertain equality in entry attitude. To begin the implementation of the strategy as in Fig 1 stage 1, coordinate geometry was split into five chunks. The 30 students in the class were divided by the number of chunks to produce six students each in five home groups.

In stage 2, the six students in each home group were accordingly numbered (1A, 1B, 1C, 1D, 1E & 1F), (2A, 2B, 2C, 2D, 2E & 2F), (3A, 3B, 3C, 3D, 3E & 3F), (4A, 4B, 4C, 4D, 4E & 4F) and (5A, 5B, 5C, 5D, 5E & 5F). The numbering 1-5 represent the chunks while the students were labelled A-F in each group. Students in a particular home group were assigned the same topic. The teacher appointed a group leader who moderated the discussion in each group. After about 10 minutes of discussion on a particular topic with the aid of lesson package, the teacher re-arranged them for expert groups as in stage 3. At this crucial stage, each student took about five minutes to carefully present knowledge acquired while in stage 2. The rest were encouraged to ask questions where they did not understand, and the experts responded to their concerns. In the final stage, students returned to their home groups to give feed backs on any adjustment in understanding in preparation for quiz. The data obtained from the questionnaire were tabulated using Microsoft Excel package, while means, standard deviations and bar-charts were used to address the two research questions. The three null hypotheses were tested using the Analysis of Co-Variance (ANCOVA) at 0. 05 level of significance with the aid of Statistical Package for Social Sciences (SPSS).

Results and Discussion

Research Question 1. What are the attitudes of students towards coordinate geometry lessons when exposed to jigsaw instructional strategy?

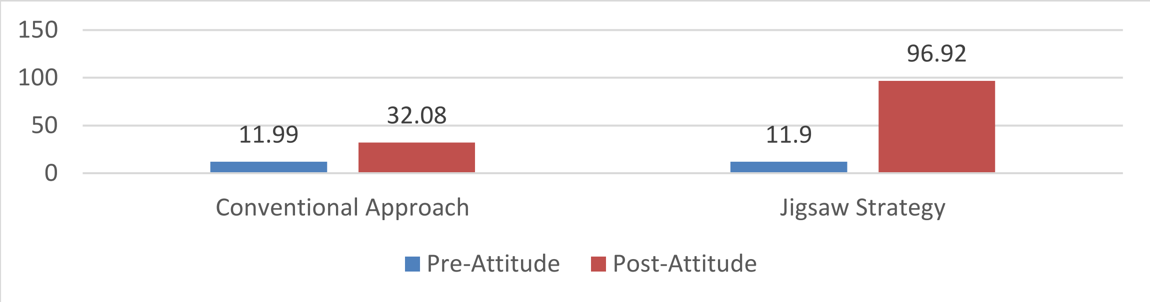

Fig 2. Students' attitudes towards coordinate geometry when exposed to jigsaw strategy.

As presented in Fig 2, the students in both groups were equally low in attitude towards coordinate geometry before treatment, but thereafter, the attitude of those taught with the modified conventional approach slightly moved from 11.99% to 32.08%, while those in jigsaw group immensely rose from 11.9% to 96.92%.

Research Question 2. What are the attitudes of students towards coordinate geometry lessons based on gender when exposed to jigsaw instructional strategy?

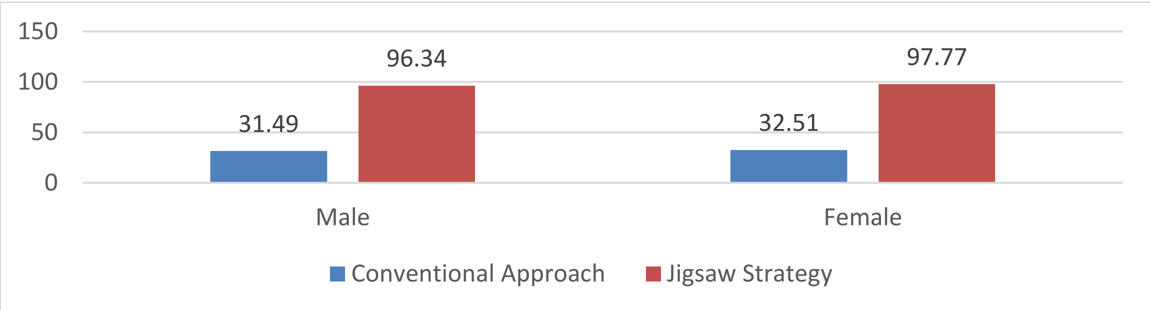

Fig 3. Students' attitudes by gender when exposed to coordinate geometry using jigsaw strategy.

The pre-test in Fig 3, revealed negative attitude of students in conventional and jigsaw groups, 31.49% and 32.51% respectively. But after the treatment, their attitude rose to 96.34% and 97.77% respectively.

Hypothesis 1. There is no significant main effect of jigsaw instructional strategy on attitude of students towards co-ordinate geometry lessons.

Table 1. Effect of jigsaw strategy on attitude of students towards co-ordinate geometry lessons

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	118841.833[a]	8	14855.229	2304.955	.000	.992
Intercept	3815.992	1	3815.992	592.094	.000	.798
Pre Attitude	5.538	1	5.538	.859	.355	.006
Group	114978.717	3	38326.239	5946.746	.000	.992
Error	966.736	150	6.445			
Total	829812.500	159				
Corrected Total	119808.569	158				

It can be seen in the result [$F(1, 150)=0.86$; $p>0.05$] in table 1, that prior to the treatment, the participants were not significantly at variant in attitude towards coordinate geometry. On the contrary, the outcome [$F(3, 150)=5946.75$; $p<0.05$] evidently showed that they differ significantly after treatment. This led to the rejection of the first null hypothesis which states that there is no significant main effect of jigsaw instructional strategy on attitude of students towards co-ordinate geometry lessons. It implies that students' were positively affected by their exposure to jigsaw strategy. The next frame will reveal the extent to which gender to produce similar/different attitudinal effect.

Hypothesis 2. There is no significant main effect of gender on attitude of students exposed to co-ordinate geometry using jigsaw strategy.

Table 2. Effect of jigsaw strategy on attitude of students towards co-ordinate geometry by gender

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	118841.833[a]	8	14855.229	2304.955	.000	.992
Intercept	3815.992	1	3815.992	592.094	.000	.798
Pre Attitude	5.538	1	5.538	.859	.355	.006
Gender	6.421	1	6.421	.996	.320	.007
Error	966.736	150	6.445			
Total	829812.500	159				
Corrected Total	119808.569	158				

The outcome $F(3, 150)=0.996; p>0.05$] in table 2, shows that the respondents did not significantly differ by gender in attitude towards coordinate geometry after the treatment. So the second null hypothesis of no significant main effect of gender on attitude of students exposed to jigsaw instructional strategy towards co-ordinate geometry lessons was not rejected. This means that gender did not relatively affect students' attitude towards the topic even after exposure to treatment. The next frame will reveal whether or not a there would be joint effect of treatment and gender on their attitude towards the concept.

Hypothesis 3: There is no significant interaction effects of jigsaw and gender on students' attitude towards co-ordinate geometry.

Table 3. Interaction effect of jigsaw and gender on students' attitude towards co-ordinate geometry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	118841.833[a]	8	14855.229	2304.955	.000	.992
Intercept	3815.992	1	3815.992	592.094	.000	.798
Pre Attitude	5.538	1	5.538	.859	.355	.006
Gender * Group	73.634	3	24.545	3.808	.011	.071
Error	966.736	150	6.445			
Total	829812.500	159				
Corrected Total	119808.569	158				

The result $F(3, 150)=3.81; p<0.05$] in table 2, shows that the respondents differ significantly in interaction effects of treatment and gender in attitude towards coordinate geometry lessons. Therefore, the third null hypothesis of no significant interaction effect of treatment and gender on attitude of students exposed to jigsaw instructional strategy towards co-ordinate geometry lessons was rejected. This means that gender did not relatively affect students' attitude towards the topic even after exposure to treatment. This means that gender does not negatively affect the potency of jigsaw strategy.

Discussion of Findings

From the findings, it is obvious that jigsaw strategy produced positive change in students' attitude towards the concept of coordinate geometry. The significant difference obtained is in tandem with Timayi (2016) who found significant difference in students' attitude in favour of Jigsaw group. It implies that students' were positively affected by their exposure to jigsaw strategy. Evidently, the result in Fig 1 buttressed the fact that no difference was observed in the conventional group as opposed to the exponential increase in attitude for the jigsaw group. The outcome of the second hypothesis showed that the respondents did not significantly differ by gender in attitude towards coordinate geometry after the treatment. The result in Fig 2 supports the fact that both the male and female students changed positively but exponentially after exposure to treatment. Moreover, Timayi (2016) also saw no significant gender difference in attitude. This means that gender was not responsible for the positive change in students' attitude towards the topic after exposure to treatment. The outcome of the third hypothesis showed that there was significant interaction effect of treatment and gender on students' attitude towards coordinate geometry lessons. This means that gender does not negatively affect the potency of jigsaw strategy when jointly considered in teaching coordinate geometry.

Conclusion

Conclusively, students exposed to jigsaw group were significantly more positive in attitude towards coordinate geometry than those exposed conventionally. The strategy is gender insensitive and is devoid of discrimination. It was observed that students' attitude towards retaining infomation is tantamount to their ability to recapture encoded skills, which is not unconnected to hatred and phobia towards the subject. The study finally submitted that negative attitude is strongly connected with underachievement in external mathematics examination due to inability to recapture previously acquired experience after a relatively long period.

Recommendations

Based on the findings, it was recommended that Curriculum developers should mandate teachers to make appropriate use of Jigsaw instructional strategy in teaching basic concepts in Mathematics; to eliminate gender difference in mathematics achievement, teachers should endeavour to teach difficult concepts in mathematics using appropriate cooperative collaborative instructional strategies such as Jigsaw–iv; and parents should eliminate fear of Mathematics especially with female students by supporting strategies that enhance effective learning irrespective of gender.

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