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ADOPTING JIGSAW INSTRUCTIONAL STRATEGY FOR IMPROVING STUDENTS' INTEREST IN MATHEMATICS

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ABSTRACT: *This study examined the adoption of jigsaw and individual personalization instructional strategies for improving the interest of senior secondary school students in mathematics. The moderating effects of students' gender and socioeconomic status were also examined. The study adopted the pre-test-post-test, control group, quasi experimental design with a 3x3x2 factorial matrix. Two hundred and fifty senior secondary two students from six public schools purposively selected from three local educational districts in Lagos-Nigeria participated in the study. Three research questions were answered and two null hypotheses were tested at 0.05 significant level. Four instruments were developed, validated and used for data collection. Data were analysed using percentages, Bar-charts and Analysis of Covariance (ANCOVA). The findings showed that there were significant main effect of treatment, gender and Socio-economic-status (SES) on students' interest in Mathematics* $F_{(2, 231)} = 27.88$; $p<0.05$; $F_{(1, 231)} = 10.64$; $p<0.05$; $F_{(2, 231)} = 5.19$; $p<0.05$ *respectively. Students exposed to Jigsaw Strategy had the highest post interest score; males students were above their female counterparts in all groups, while those of high SES had the highest post interest score. It further revealed that the 3-way interactions showed no significant interaction effects of treatment, gender and SES on students' interest in Mathematics* $F_{(4, 231)} = 1.27$; $p>0.05$*.. It was recommended that Mathematics teachers should be trained to use both Jigsaw and conventional approaches in the classroom, since they were more effective in arousing and increasing students' interest in Mathematics than the individual personalization instructional strategy.*

KEYWORDS: Jigsaw Instruction, Students' Interest in Mathematics, Gender, SES

INTRODUCTION

Admittedly, most students dislike mathematics, despite its immense contributions to individual, group and societal development (Chiason, Kurumeh & Obida, 2010). This hatred for mathematics has resulted in loss of interest and poor performance in the subject when examined. Lack of interest in mathematics among many students, over the years, has been a major concern to educators (Hidi & Harackiewicz, 2000). Fredricks and Eccles (2002); Watt (2004) found downward developmental trends of Mathematics interest among students at secondary school level.

Interest is conceived by Beier and Rittmayer (2008) as a determinant of the valence components of expectancy-value models. It is a motivational variable that is linked with educational attainment in that students are more likely to engage in an academic activity, pay more attention, and generate higher performances if they are interested in the topic (Schunk, Pintrich and Meece, 2008). It can also be seen as the desire to re-engage in content over time, to seek answers to questions, to acquire more knowledge, and to promote achievement and

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excellence in education as well as professional careers. Frenzel, Goetz, Pekrun and Watt (2006) saw it as an important force determining the quality of learning, educational and occupational choices. Moreover, it can be described as an important variable in learning mathematics because when one becomes interested in an activity, one is likely to be more deeply involved in that activity (Okigbo and Okeke, 2011). Imoko and Agwagah (2006) also defined interest in mathematics as a subjective feeling of concentration or persisting tendency to pay attention and enjoy some activity or content in mathematics. Interest in mathematics guides our behaviours in making choices.

Nevertheless, lack of interest in mathematics has direct implications for student motivation to learn skills needed for accomplishing everyday tasks and for student involvement in science, technology, engineering, and mathematics (STEM) disciplines, particularly for females (Amelink, 2012). While student interest in mathematics is low overall, female interest in mathematics is markedly lower than that of their male peers (Frenzel, Goetz, Pekrun, and Watt, 2010; Amelink, 2012). Lower interest is closely related to lower performance on mathematics-related achievement tests and lower grades in mathematics (Uerz, Dekkers, and Beguin, 2004), less interest in taking challenging mathematics curricula prior to enrolling in college and less interest in pursuing a career in science disciplines (Usher, 2009), with females at a higher risk (Usher, 2009). The low interest in mathematics could also emanate from mathematics anxiety and fear (Okigbo and Okeke, 2011). While social and cultural factors also manifest themselves as gender-based stereotypes in educational settings whereby girls receive implicit and explicit messages from parents, teachers, peers, and the media that mathematics is a male-dominated field that is of little use to women, who should be more interested in socially based endeavors (Amelink, 2012).

Moreover, Kessels and Hannover (2007) submitted that lack of interest in mathematics is further worsened by factors emanating from teachers, school, parents and government. The issue of students' low interest in mathematics is also caused by students' inactivity in the classroom which is characterised by the traditional method of teaching in senior secondary schools (Akinsola & Ifamuyiwa, 2008; Areelu & Dawodu, 2015). Thus, the strategies that will familiarize the students with the contents of instruction, increase their interest, empower them with sufficient level of mathematical proficiency and enhance their active participation in the subject and also efficacious in improving their interaction with the environment are highly needed. Hence this article focused on improving students' interest in mathematics through cooperative collaborative strategies that promote class interaction and participation.

One of such strategies is the Jigsaw. It is a cooperative learning technique in which students work in small groups of four to six (Aronson, 2008; Lestik & Plous, 2012; Hakkarainen, 2012). It is used to develop the skills and expertise needed to participate effectively in group activities which also focuses on listening, speaking, co-operation, reflection, and problem-solving skills in the students (Bratt, 2008; Hakkarainen, 2012). Jigsaw strategy, according to Gregory (2013) can be used for students by giving them different materials and content to match different levels of readiness. Products, projects, or other authentic tasks and assessment that are expected from the group, based on their preferences and multiple intelligences, offer another way to differentiate. Also, the jigsaw method facilitates the sharing of responsibility for learning (Perkins and Saris, 2001). It helps focus energy in a task and provides structure and process for the learning. It has inter- and intrapersonal components that also allow students to process information, move and interact with a variety of class members to gain a greater perspective on the knowledge or skills that are targeted for

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learning. It offers many chances for elaborative rehearsal and use of higher-order thinking through dialogue (Gregory, 2013).

Contextually, some researchers asserted that if the mathematics contents are phrased to students in a personalized way, the success, attitude, motivation and interest of the students are raised (Cakir, Simsek & Tezcan, 2009, Areelu & Dawodu, 2015). Hence, the adoption of individual personalization instructional strategy becomes pertinent. Individual Personalization is defined by Diack (2004) as putting a person's individual needs in the center of his/her life and building his/her life on this basis. It also involves embedding students' past experiences and interests into the Mathematics content (Simsek & Cakir, 2009). Therefore, individual personalization is described by Lopez and Sullivian (1992) as tailoring the domain context of instruction to an individual rather than the whole class common interest and preferences. It valorises all the potential of each learner and further recognises the individual strength, needs and goals. It enables schools respond to differences in learning by tailoring the content of instruction to meet each student's needs in his/her locality. It is accomplished by incorporating personal information and preferences provided by each student into their Mathematics problems. In this work, the authors incorporate the biography, intelligences, sensibilities and competences of each student into the content of instruction. This enables each student to relate the content to his or her life experience during the intervention.

Consequently, a number of research gathering information on some variables having the potential of influencing student's interest irrespective of the instructional strategies adopted, have emmerged. The social, economic, and cultural factors that are either in favour of or not conducive to senior secondary school students are not well understood. These variables according to Tian (2006) and Ababa, Gallarde, Gica, Gillado, Laoc, and Oncone (2012) included family background factors, such as number of parents, number of siblings, parents' socioeconomic status (SES), gender, language problem, native and minority. For the fact that previous empirical research on effects of SES variables on students' interest under individual personalization and jigsaw strategies were not readily assessable during the quest, the authors limited empirical findings to the results of this analysis. However, gender related literature were captured. The effect of gender as a moderating variable on students' interest has also been demonstrated (Hedges & Nowell, 1999).

Besides teaching strategies, gender is a student's background factor examined in this study that influences the interest of students in mathematics. Gender according to Udousoro (2011) is defined as a cultural construct that distinguishes the roles, behaviour, mental and emotional characteristics between females and males developed by a society. It is a psychological term used in describing behaviours and attributes expected of individuals on the basis of being born as either male or female (Umoh, 2003). Gender difference is a recurrent theme in academic studies both in general studies and mathematics in particular. According to Farooq and Shah (2008), girls are often discouraged from mathematical work in their primary years and they later drop it at high-grade levels in far greater numbers than boys. Also, a recent study demonstrated that having a female teacher who says she is anxious about mathematics leads females in her class to share that attitude and score lower on tests (Beilock, Gunderson, Ramirez, & Levine, 2010).

Furthermore, parents tend to view mathematics as a more masculine field and buy more mathematics-related products for their sons than for their daughters (Bleeker & Jacobs, 2004). These messages, although unfounded scientifically, starting with influential adults

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such as parents and teachers, are picked up and furthered by peers (Barnett and Rivers, 2004), and are reinforced by media, including magazines, television, and textbooks used in schools. When considering the long-term impact, lack of interest in mathematics among females is directly related to fewer female pursuing degrees in mathematics-related careers, including science, technology, and engineering (Spelke, 2005 & Watt, 2006). Female interest in mathematics is markedly lower than male interest (Frenzel, Goetz, Pekrun, and Watt, 20o6; Nosek, Banaji, and Greenwald, 2002).

Empirically, Mbacho (2013) identified several factors attributed to the students' dismal performance and lack of interest in the subject to include: inadequacy of facilities in the schools like the text books, qualified teachers, poor attitude towards the subject by the students, teachers, gender stereotypes, lack of role models, and the instructional methods used by teachers. Alcock, Attridgeb, Kenny and Inglisa (2014) investigated two factors that predict students' achievement and behaviour in undergraduate mathematics: gender and personality. They found that gender predicted students' achievement and behaviour when considered in isolation, but ceased to be predictive when personality profiles were taken into account. It was therefore submitted that personality provides the more productive lens through which to understand the behaviour of undergraduate mathematics students. The findings relate to research emphasising gender differences in mathematics education, and suggest that researchers wishing to promote equity in participation at and beyond the undergraduate level should consider shifting their focus to individual differences in personality. In lieu of this, the authors felts that variance in students' interest at secondary school level can be revealed when Jigsaw-strategy is investigated. Besides, it is believed that Jigsaw instructional strategy is capable of enhancing student's interest at this level.

Timayi (2016) examined the Effects of Jigsaw IV Cooperative Learning Strategy (J4CLS) on Interest and Academic performance of 144 Secondary School 2 Students in Geometry in Kaduna State, Nigeria. The study focussed on solving the persistent low interest and poor performance of students in geometry at the senior secondary school level. The results obtained showed a significant difference in performance in favour of student exposed to the Jigsaw. The results also revealed no significant difference in performance of male and female students when exposed to the Jigsaw. The result further revealed a significant difference in interest level in favour of student exposed to the Jigsaw but no significant difference was found in interest level between male and female students in the experimental group and between male and female students in the control groups respectively. Chiason, Kurumeh and Obida (2010) did a similar investigation on the same level of students with similar outcomes. They found significant difference in interest level in favour of student exposed to the Jigsaw but no significant difference was found in interest level between male and female students in the experimental group and between male and female students in the control groups respectively.

It can be deduced from the foregoing that for students' mathematics interest to be improved upon, irrespective of gender, teachers should provide meaningful, practical and authentic learning activities to enable students to construct their understanding and knowledge of this subject domain. Thus, instructional strategies that can increase students' mathematics interest, familiarize them with the contents of instruction, empower them with sufficient level of mathematical proficiency and enhance their active participation in the subject and also efficacious in improving their interaction with the environment are highly needed. Therefore, this study examined the uses of jigsaw and individual personalization instructional strategies

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for improving the interest of senior secondary school students in mathematics. The moderating effects of students' socioeconomic status and gender were also examined.

Research Questions

The following three research questions were raised and answered by means of percentage gains in interest and Bar-charts:

1: Do students differ in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

2: Do students differ by gender in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

3: Do students differ by SES in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

Hypotheses*:*

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

Ho_1: There are no significant main effects of treatment (Jigsaw, Individual personalisation and conventional method), gender and socioeconomic status on students' Interest towards Mathematics.

Ho_2: There is no significant interaction effect of treatment, socioeconomic status and gender on students' Interest in Mathematics.

RESEARCH METHOD

This study adopted the pre-test, post-test control group quasi-experimental design involving a 3 x 3 x 2 factorial matrix. Learning strategies (Jigsaw, Individual Personalisation and Conventional Instructional Strategies) were crossed with socioeconomic status (low, average and high) and gender (male and female).

Participants:

The participants for this study comprised all the Senior Secondary School Two students (SSS II) drawn from Secondary Schools in Epe, Ibeju and Ikorodu in Lagos State, Nigeria. The choice of SSS II students was considered more appropriate because these students have been exposed to some basic Mathematics concepts and skills which would enable them to solve algebraic problems. Besides, students had enough time for the experiments since they were not preparing for any external examination. In addition, these students were willing and free to express their opinions and interest in Mathematics. Three out of 20 Local Educational District *(LEDs)* in Lagos Sate were used. The participants include: *139 males, 111 females,* 97 in Jigsaw, 90 individual personalisation and 63 conventional group respectively, (124 belong to low, 45 in average and 81 high SES respectively, making a total of 250 students. The participants were subjected to varied academic ability levels. The selected groups in each LED were purposively assigned to a treatment group so as to avoid interaction that may occur

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

Instruments

Four research instruments were used in this study. These are: (i) Students' Mathematics Interest Questionnaire (SMIQ) (ii) Socioeconomic Status Questionnaire (SESQ), Personal Interest Inventory (PII) and Teacher's Instructional Guide (TIG).

Students' Mathematics Interest Questionnaire (SMIQ)

The SMIQ is a 27-item scale which is made up of two sections, Section A (Students' background information) and Section B (items that determined student's interest). Students' method of response to the item was a 5-point likert scale of strongly agree (SA), agree (A), Undecided (U), disagree (D) and strongly disagree (SD). This instrument was adapted from Interest scale developed by Holland (1959). It was considered valid and reliable for testing and measuring students' interest by Schiefele (1991), Krapp (1999) and Su, Rounds and Armstrong (2009). The instrument was given to 80 SSS II students that were not part of the study and the reliability coefficient using Cronbach Alpha Reliability Method was found to be 0.88.

Socioeconomic Status Questionnaire (SESQ)

SESQ was made up of two sections, Section A (parents' socio-economic factors and information) and Section B (15 items on students' academic performance). Students' method of response to the items was the closed response mode of 5-point likert scale of strongly agree (SA), agree (A), Undecided (U), disagree (D) and strongly disagree (SD). This instrument was adopted from 10-item Parents' Socio-economic Status Scale (PASS) developed by White et al in 1993. It has been considered by Safdar Rehman Ghazi et al (2013) to be valid and reliable instrument for testing students' socio-economic status and academic performance. The instrument was given to 80 students that were not part of the study and the reliability coefficient using Cronbach Alpha Reliability Method was found to be 0.73.

Personal Interest Inventory (PII)

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

Teacher's Instructional Guide (TIG)

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

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Learning Packages

Though, three approaches were investigated, only two learning packages developed and validated by the researchers were used as intervention in the experimental groups. There was no learning package for the control group because students in this group were taught conventionally by their teachers using lecture method.

Jigsaw Instructional Package (JIP)

This is a text-assisted programmed instructions designed and validated by the researchers where each student specializes in a sequence, while receiving the rest from his colleagues. It was the treatment (stimulus instrument) that was used by the first experimental group (Jigsaw Instructional Strategy, E_1) covering five broad topics in Mathematics. It contained 25 lessons covering five weeks of five periods per week as contained in the scheme of work for SSS II classes in Mathematics. The broad topics covered were: approximations and percentage error, ratio, proportions and rates, percentages, sequence and series, concept of sequence and series, terms of A.P and sum, solving problems on A.P., terms of G.P. and sum, problem solving on G.P, Geometric mean, simultaneous equations; one linear and one quadratic solution by substitution method, solving more problems on the topic, word problems on simultaneous equation. The students were divided into five heterogeneous groups and appropriate group works for each of the five broad topics was constructed and were used to teach each of these groups of students made up of the working groups.

Students with the same number on their form were organized into groups of “experts” who would actually perform tasks on the worksheets. After a period of time, as agreed with the teacher and the research assistants, the students were assembled in original work groups, where they showed and discussed their expert work, in turn, to the colleagues, until the “whole” designed by researcher, was achieved through the contribution of each student group, within the group. The JIP was trial-tested on a group of 80 SSS II students having characteristics similar to the intended students for the main study. The feedback obtained from the learners, as it concerned the length and timing of the lessons, the simplicity or otherwise of the examples and solutions provided as well as the workability of the package for the study, was used to further modify the JIP in order to make it useful and suitable for the main study.

Individual Personalisation Instructional Package (IPIP)

The IPIP is similar to the JIP in content and model. It was also a developed and validated programmed instruction designed by the researchers to develop the students’ skill in personalisation. It was the treatment (stimulus instrument) that was used by the second experimental group (Individual Personalisation Instructional Strategy, E_2). The IPIP was a programme of teach your peer (peer-tutoring) the curricula content as developed by the teacher in the package. Before the development of the IPIP, 20-item student survey was used to determine the personal backgrounds and interests of the participants. Topics included the names of the individual student’ favourite places, activities, sports, friends, convenience stores, foods, and so forth. Students gave two favourite responses for each survey item. The survey was administered one week prior to the pre-test. Responses to each survey item were tabulated and then used to design the personalised version of the instructional programme and the tests. The stimulus part of the IPIP was prepared in groups, week by week, while the response part was produced separately. Each student received first the response part after

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each lesson in other to solve the relevant exercises in group, in line with the instructions in the package. This ensured that the ‘student learning’ personalisation model chosen for the study was properly utilized during the treatment and data collection period. The IPIP was also trial-tested on a different group of SSS II students having characteristics similar to that of the intended subjects for the main study. It was also administered on 80 SSS II students. This was done in order to find out its suitability for the main study. The feedback obtained from the learners, especially as it concerned the workability of the package for learner, was used to further modify the IPIP in order to make it useful and suitable for the main study.

Data Collection Procedure

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

(a) Pre-Intervention Phase

The actual pre-intervention phase followed the steps below:

The researchers, as the resource persons, trained the six participating teachers and two research assistants for two weeks. With the TIG, the participating teachers were trained on the use of the learning packages (JIP and IPIP), how to create the right type of environment for the experimental and control groups and how to administer the other instrument (SMIQ and SESQ). The participating teachers used the third week for trial testing. This was done to ensure that the teachers mastered the intervention for the experimental and control groups and applied it throughout the intervention period. The two research assistants were asked to rate the participating teachers (using the intervention rating scale prepared by the researchers) during the trial practice. The exercise produced inter-rater reliability values of 0.78 and 0.86 range.

(b) *Intervention Phase*

The fourth week was used for pre-test. The researchers with the help of the research assistants and the trained teachers administered the pre-test to the participating students in the following order: Socioeconomic Status Questionnaire (SESQ) before the Student Mathematics Interest Questionnaire (SMIQ). The intervention period took five weeks in each of the six schools. This involved the use of the JIP for the students in the experimental group 1, the use of the IPIP for those in the experimental group 2 and the use of the conventional (lecture) method of teaching for the students in the control group. During the intervention period, no interaction was allowed between the students in the intervention and control groups, whose schools were located in different areas.

(c) *Post-Intervention Phase*

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

RESEARCH FINDINGS

Percentage interest gains and bar-charts were used to answer the three research questions and the results are presented as follows:

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Research Question 1: Do students differ in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

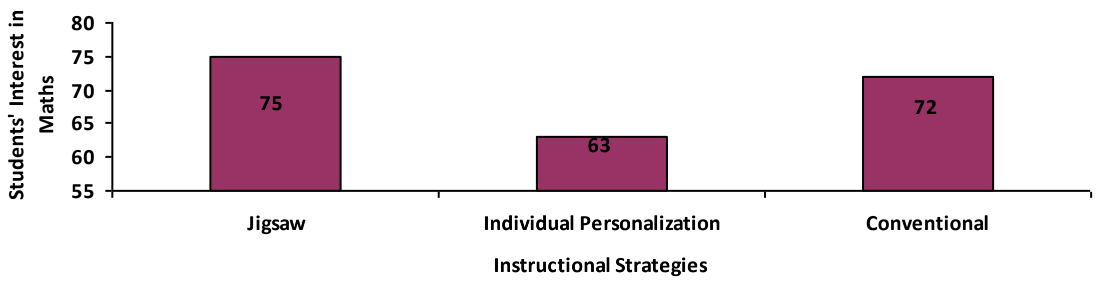

Fig 1: Students' Interest in Mathematics by Instructional Strategies

Fig 1 shows that students differ in interest towards mathematics when exposed to jigsaw, individual personalization and conventional strategies. It revealed that students of Jigsaw have the highest interest (75%) while those taught conventionally (72%) are higher than those in individual personalization group (63%).

Research Question 2: Do students differ by gender in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

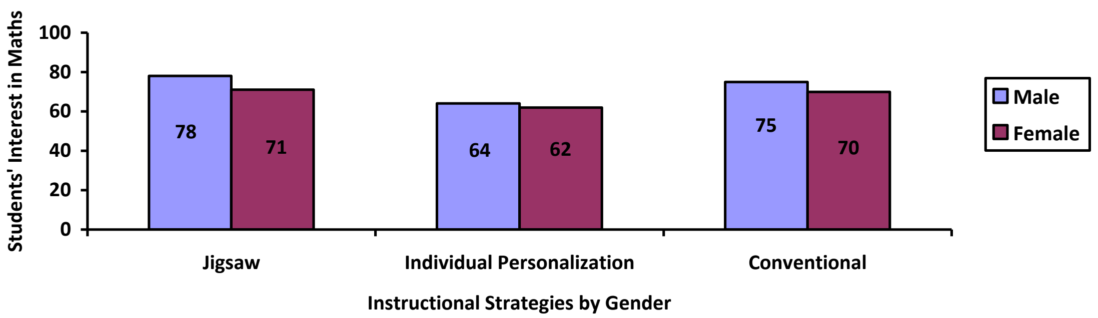

Fig 2: Students' interest in mathematics by Instructional Strategies and Gender

Fig 2 shows that male students have higher interest gain than the females in both experimental and control groups. The interest gains for male and female students 78% and 71%; 64% and 62%; 75% and 70% respectively for Jigsaw strategy, Individual Personalization strategy and Conventional method.

Research Question 3: Do students differ by SES in interest towards mathematics when taught using Jigsaw, Individual Personalization and Conventional Strategies?

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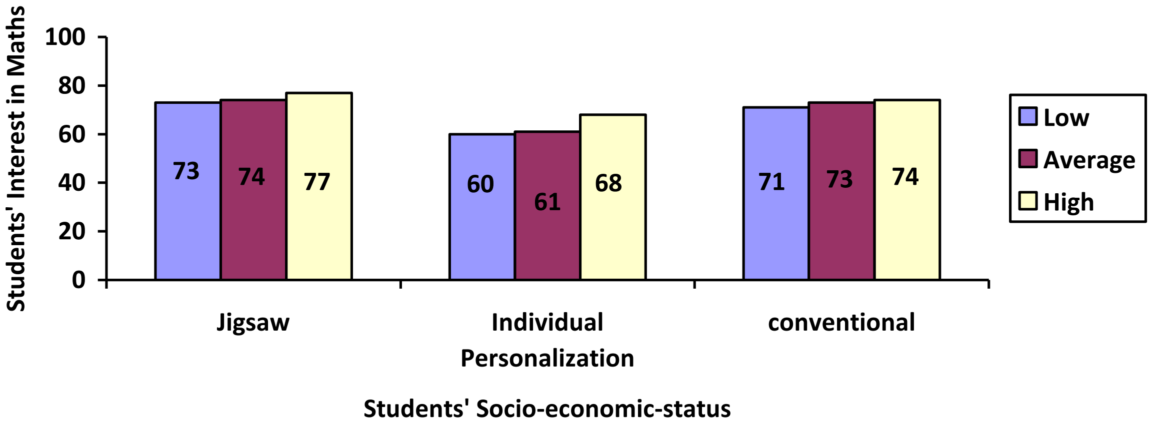

Fig 3: Students' Interest in mathematics Instructional Strategies and SES

Fig 3 shows that students of high SES have higher interest in mathematics than those of average SES while those of average SES are higher than those of low SES irrespective of teaching strategies. It revealed that students of low, average and high SES have interest gains of 73%, 74% and 77% for Jigsaw Strategy, 60%, 61% and 68% for Individual Personalization Strategy; and 71%, 73% and 74% for conventional method.

Table1: Effects of Treatments, Gender and SES on Students' Interest in mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12442.854[a]	18	691.270	8.356	.000	.394
Intercept	247.996	1	247.996	2.998	.085	.013
PreInterest	287.837	1	287.837	3.479	.063	.015
Group	4612.867	2	2306.433	27.880	.000	.194
Gender	880.464	1	880.464	10.643	.001	.044
SES	858.020	2	429.010	5.186	.006	.043
Group * Gender	209.037	2	104.519	1.263	.285	.011
Group * SES	162.588	4	40.647	.491	.742	.008
Gender * SES	7.633	2	3.817	.046	.955	.000
Group * Gender * SES	419.650	4	104.913	1.268	.283	.021
Error	19109.822	231	82.727			
Total	1255293.000	250				
Corrected Total	31552.676	249				

a. R Squared = .394 (Adjusted R Squared = .347)

DISCUSSION OF FINDINGS

Hypothesis 1: There is no significant main effect of treatment, gender and socioeconomic status on students' Interest in Mathematics.

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The results in table 1 indicate that the students who did not differ significantly in interest towards mathematics before the treatment $F_{(1, 231)} = 3.48$; $p>0.05$ had significant main effects of treatments on their interest towards mathematics $F_{(2, 231)}= 27.88$; $p<0.05$. As supported by Fig 1, the results showed that jigsaw instructional strategy was more effective at improving students' interest in mathematics, followed by the conventional method of teaching while individual personalization instructional strategy was the least effective. The effectiveness of jigsaw instructional strategy over both individual personalization instructional strategy and conventional teaching method may be due to the fact that jigsaw instructional strategy is learner-centered, characterized by both personal and group efforts. Individual effort must have been enhanced when students were divided into home-groups and expert-groups in which members of expert-groups access information or learn new concept, content or material that would in turn be transferred to their home-groups. This develops the skills and expertise needed to participate effectively in group activities which also focuses on listening, speaking, co-operation, reflection, and problem-solving skills in the students. Also, the conventional method exhibited superiority in improving students' interest over the individual personalization instructional strategy. This may be due to the fact that students are left with a single peer or partner after being given an instructional package of the individual personalization strategy. In individual personalization strategy, students learn from only one partner or peer without having the opportunity to interact within themselves. This finding is in agreement with the submissions of Chiason, Kurumeh and Obida (2010); Timayi (2016).

The result in Table 1 again shows that there was a significant main effect of gender on students' interest in mathematics $F_{(1, 231)} = 10.64$; $p<0.05$. It implied that the male and female students who participated in the study were significantly different in interest in mathematics. However, results in Fig 2 reveals that male students who participated in the study recorded better post interest mean score of 78%, 64% and 75% than the females who recorded post interest mean score of 71%, 62% and 70% against jigsaw, individual personalization and conventional strategies respectively. The significant main effect of gender on students' interest in this study is in disagreement with the findings of Beilock, Gunderson, Ramirez, and Levine (2010), Frenzel, Goetz, Pekrun, and Watt (2010), Spelke (2005) and Bleeker and Jacobs (2004).

The results in Table 1 further revealed a significant main effect of SES (low, average and high) on students' interest in mathematics $F_{(2, 231)} = 5.19$; $p<0.05$. This result showed that the post mean interest scores of the students of low, average and high SES were significantly different from one another. However, students of high SES ranked first in the post interest while those of low SES ranked lower than those of average SES as seen in Fig 3. So the null hypothesis 1 was rejected because there were significant main effects of treatments, gender and SES on students' interest towards mathematics. This implies that the strategies are effective tools for improving students' interests in mathematics irrespective of gender and SES. These findings are in agreement with the submissions of Ababa et al (2012), Garzon (2006) and Jeynes (2002) and Crane (1996).

Hypothesis 2: There is no significant interaction effect of treatment, socioeconomic status and gender on students' Interest in Mathematics.

The result of the 3-way interaction effects in Table 1 reveals no significant interaction effect of treatment, socioeconomic status and gender on students' interest in mathematics $F_{(4, 231)} = 1.27$; $p>0.05$. This result implied that there is no significant difference in students' group-interest in mathematics based on treatment, gender and SES combinations: low-boys, low-

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girls, average-boys, average-girls, high-boys and high-girls. Hence, the null hypothesis 2 was not rejected. This implies that gender effect on students' interest in mathematics when exposed to jigsaw, individual personalization and conventional strategies is better treated independent on SES, much the same way SES effect on interest is better handled independently. The report of Alcock, Attridgeb, Kenny and Inglisa (2014) showed that gender predicted students' achievement and behaviour when considered in isolation, but ceased to be predictive when personality profiles were taken into account.

CONCLUSION

This study determined the uses of jigsaw and individual personalization instructional strategies for improving the senior secondary students' interest in Mathematics. The study is an extension in the use of learning packages that emphasize the active participation and intellectual involvement of learners. There were significant main effects of treatment, gender and Socioeconomic Status on the students' interest in Mathematics. But no significant interaction effects of the three variables were determined. The result of the study further revealed that Jigsaw strategy is the most effective strategy while the conventional method is more effective than the individual personalization instructional strategy through the use of learning packages in the teaching and learning of mathematics.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

- Mathematics teachers should embrace both traditional method of teaching and the use of Jigsaw instructional strategy.
- Teachers should be trained to develop their skills in the preparation and development of learning packages and how to use the packages to assist their students in learning Mathematics so that learners will develop a positive interest in Mathematics.
- Also, teachers must not discriminate among students with high, average or low socioeconomic status.
- Governments and school administrators at the secondary school level should provide the needed facilities and encourage Mathematics teachers toward the development of valid learning packages.
- The curriculum planners should design a course that will be specially made for designing packages in all tertiary institutions. More textbooks should be written in the form of lesson packages to lessen the teacher's burden in our secondary schools.
- Our educational system should embrace other instructional strategies that are capable of making the teaching and learning of Mathematics more practical, interesting and relevant to everyday life irrespective of the gender and Socioeconomic Status of the learners.

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