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EFFECT OF JIGSAW II AND THINK-PAIR-SHARE INSTRUCTIONAL STRATEGIES ON STUDENTS' ACQUISITION OF SCIENCE PROCESS SKILLS IN PRACTICAL BIOLOGY IN NASARAWA STATE, NIGERIA

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Abstract
The study investigated the Effects of Jigsaw II and Think-Pair-Share Instructional Strategies on Students' Acquisition of Science Process Skills in Practical Biology. The study adopted a quasi-experimental pretest-posttest control group design. The population for this study comprised 13,426 (7047 Male and 6379 Female) SSI students in West Senatorial District, Nasarawa State, Nigeria. A sample of 112 Senior Secondary One (SS1) student were drawn from three co-educational public senior secondary schools in West Senatorial Districts of Nasarawa State. Three research questions guided the study and three null hypotheses formulated and tested at 0.05 level of significance. A multi-stage sampling technique was used and arrived at one intact class each from the schools. The schools were randomly assigned to two treatment groups; Jigsaw II and Think-Pair-Share Instructional Strategies, and Control Group. An instrument titled Practical Biology Process Skills Acquisition Test (PBIPSAT) was developed, validated and used for data collection. PBIPSAT consists of 25 Multiple Choice Items (MCI) and 5 Practical Skills Test (PST) for assessing students' acquisition of science process skills of experimentation, observation, identification, reporting and inferences. PBIPSAT has a reliability coefficient (internal consistency) of 0.85 was determined using split half methods. Mean and Standard Deviation were used to analyze the data while the null hypotheses were tested at 0.05 alpha level using Analysis of Co-variance (ANCOVA). A post hoc Analysis using Bonferroni test was done to determine the direction of superiority of means by Pair-wise Comparison based on the estimated marginal means. The results showed significant difference in the process skills mean scores in favour of Think-Pair-Share Instructional Strategy (TPSIS), followed by the students in the Jigsaw II Instructional Strategy (J2IS) with the Control Group having the least process skills mean scores. However, no significant difference was found between the process skills mean scores of males and females in the JIIIS and TPSIS methods. On the basis of this findings, it was therefore, recommended among others that teachers should be

encouraged through organizing seminars, workshops and conferences, on the efficacy and the usefulness of TPSIS so as to improve students' acquisition of science process skills. Biology students' teachers during their pre-service training also be encouraged to use TPSIS and J2IS in order to eradicate the issue of poor performance, lack of interest as well as gender difference during delivery the concept of photosynthesis in a Biology class.

Introduction

Nations throughout the world have embarked on investment on science education in an attempt to produce scientists, engineers, technologists and technicians as well as scientifically literate society for sustainable growth and technological advancement to meet up with the challenges of the world. Barreth (2015) stated that meaningful engagement of science technology manpower translates into industrial and technological growth, which is the hallmark of national development. Similarly, the World Summit for Development recommends that people should be empowered through science education to achieve the 3 goals of poverty eradication, employment opportunities and value orientation (Ajeleyemi, 2011). Ercarta (2015) remarked that there is the need for basic standard of science learning in preparing individuals for occupation in a highly scientific and technological environment.

In recognition of this, the Federal Republic of Nigeria (FRN, 2013) in the National Policy on Education (NPE) incorporated acquisition of appropriate skills both mental and physical as equipment for individuals to live and contribute to the development of their society as one of the national education goals. However, it has been noted that students at all levels show poorly developed skills of problem analysis, planning and carryout control experiments (Hacling & Garnett, 2015). These are areas or skills that prepare individuals for scientific explorations and endeavours to meet up with the national and world aspirations at large.

However, several research reports (Omiko, 2013; Nweze, 2014 & Nweke, 2015) found that students achieve poorly in science. Uzoechi (2014) stated that science students do not only perform poorly in the cognitive level, but also perform badly in affective and psychomotor skills, respectively. Dzama and Oshorbone (2012) remarked that the poor performance of students in developing countries is not just due to the world views of students in their countries, but due to supportive environment for serious science learning where science features significantly in a popular culture.

Biology is a science of life and is offered in all senior secondary schools in Nigeria which attracts the greatest patronage of both science and arts-based students (Nwosu, 2016). Urevbu (2009) pointed out that the teaching of Biology is important because it equip students with necessary skills to build a progressive society. Similarly, Nwosu (2016)

observed that Biology provides a platform for teaching students to develop the ability to apply concepts and principles in solving everyday life problems. With knowledge explosion all over the world through internet, the knowledge of biological science has also expanded. There are advances recorded in the field of Biology such as Biochemistry, Physiology, Ecology, Genetics and Molecular Biology that has made the subject a central focus in most human activities including problems like food scarcity, pollution, population, radiation, disease, health, hygiene, family life, management and conservation of natural resources as well as Biotechnology and Ethics. Maduabum (2014) summed it all that Biology is the most fundamental of all the natural sciences because of the vital role it plays in the various aspects of the economic and public life such as crime detection, disease control, agriculture, health, industries, research and teaching.

Despite the relevance of Biology, performances of students in Biology have not been very impressive most especially in the area of process skills acquisition, This is evident from the available statistics of WAEC results from schools under Nasarawa State Ministry of Education and the results from West African Examination Council (WAEC) (2016 to 2020) Chief Examiners reports on senior secondary school students' performance in Senior Secondary Certificate Examinations (SSCE) Biology which revealed that many candidates performed below average.

Table 1: Nasarawa State Students' Performance in SSCE Biology from 2014-2018

Year	Percentage passes at grade (1-6)	Percentage Failure (F9)
2016	53.14	46.86
2017	32.74	67.26
2018	41.80	58.2
2019	31.86	68.14
2020	39.44	60.56

Source: Department of Education Resource Centre (ERC), Nasarawa State Ministry of Education, Lafia.

Table 1, shows that the average percentage of passes at credit level over the period of 5 years is only 40.21 and 44.16 while the average percentage of failure is 59.79 and 55.84 for the state and the general results respectively. The WAEC chief examiner's reports for the period in question (2016- 2020) indicate that the poor performance in Biology is largely due to poor performances in practical aspect in Biology. Omiko (2016) and Nweke (2017) were of the same opinion when they observed that the poor performance in practical work is synonymous with poor acquisition of science process skills.

The process dimension of science is considered to be of primary importance as it usually gives rise to the product. The process dimension of science can be treated under science

process skills. Science process skills refer to those basic tools, tactics or techniques which are utilized in the study of science (Anaekwe, 2017). They are cognitive and psychomotor skills which scientists employ in problem identification, objective inquiry, data gathering, transformation, interpretation and communication (Nwosu, 2013; Funk, 2016). Collete and Chiapetta (2017) classified science process skills into basic or integrated. Basic science process skills are the fundamental skills which are usually employed in almost all scientific endeavours. These include observing, classifying, comparing, communicating, measuring, recognizing, experimenting, inferring and predicting (Funk, 2016). The basic science process skills provide the ground work for problem solving. On the other hand, the integrated process skills are combination of two or more basic process skills and are therefore more advanced than basic process skills. They are the immediate skills that are used in problem solving. These include such skills as identifying variables, formulating hypothesis, describing relationship between variables, designing, investigating, experimenting, acquiring data, formulating models, defining variables operationally, understanding cause and effect relationship (Funk, 2016). Brotherton and Preace (2009) noted that scientists can only use integrated skills effectively once they have mastered the basic process skills. Science process skills can be acquired and developed through training such as those involved in practical activities. Studies by Nwosu (2013) and Okoli (2016) assert that when one acquires the science process skills of observing, measuring, questioning, designing, experimenting, interpreting data, inferring, such person becomes specially equipped with tools required for scientific inquiry, problem solving as well as the ability to use the skills in the laboratory for a variety of scientific investigations. Thus, any meaningful learning of science by students must include the acquisition of science process skills and many science curricula have been modified to reflect this emphasis so as to meet with the challenges of science and technology.

Omiko (2013) and Nweke (2017) indicates that a number of factors have been identified as contributing to non-acquisition of science process skills by secondary school Biology students which invariably lead to poor academic performance and one of the factors is the teacher variable, that is, the teacher's method of teaching. They maintain that the interest which students show in practical Biology and the mastery they demonstrate on completion of a course of study depends to a large extent on the interest and teaching methods that are geared towards process skills acquisition.

The Jigsaw II cooperative learning method was developed by Robert Slavin in 1987, having adapted Elliot Aronson's Jigsaw technique. Jigsaw II learning technique is one of the cooperative leaning techniques that is based on group dynamics and social interactions (Slavin, 2015). Acikgoz (2016) stated that it is one of the "pure" cooperative learning techniques. This technique includes two different treatments with different

small groups in order to help learning and improving cooperation between students. In the application of Jigsaw II technique, students separate from their own groups and form new groups with the other students who are responsible for preparing the same subjects. These groups, called "groups of experts" try to make other students understand the subject; they make plans about how they can teach the subject to their colleagues, and prepare a report. Afterward, they return to their own groups and teach the subjects to them with the help of the reports they have prepared. In the last stage, teachers can perform some activities with individuals, small groups or the whole class in order to unify students learning. For instance, he/she can make one of the home groups or individual students make presentation in the classroom on their subjects. In the evaluation stage, the study is completed by making the evaluation proposed by the cooperative learning method (Karacop, 2017; Simsek, 2015). Lucas (2017) indicates that Jigsaw II technique allows students to actively participate in learning process. Yusuf and Gizaki (2016) maintains that if students are being constantly subjected to this method, they feel more comfortable about their roles. Ways of evaluating the groups can enhance the effectiveness of the Jigsaw II technique by making each student have a sense of responsibility for their groups' performances.

Heden (2013) remarked that Jigsaw II method resembles the original Jigsaw method in some way but has its own objectives to be fulfilled. Heden maintain that while the Jigsaw method focuses on the students' comprehension of the instructor's material, the Jigsaw II technique focuses on the participant's interpretations such as perception, judgments through a very active discussion/ task. This method is best advised to give explanation/activities before the discussion of the topic takes place. This ensures that the learners are more effective in their discussion but also saves time (Samuel, 2018). It encourages inclusiveness and social interaction which is vital in skills acquisition. It is guided by five elements including face-to-face interaction, positive interdependence, individual accountability, group processing and social skills (Johnson and Johnson, 2008 & Long-Crowell, 2015). In this study, Jigsaw II was utilized alongside Think-Pair-Share instructional strategies to find out their effects on students' acquisition of science process skills in practical Biology in Nasarawa State, Nigeria.

Think-Pair-Share on the other that hand is a cooperative learning strategy that derives its name from the stages of learners' actions while implementing the strategy with emphasis on what learners are expected to do at each of the stages (Johnson & Johnson, 2008). Think-Pair-Share Cooperative Learning is a cooperative learning strategy first developed by Frank Lyman of the University of Maryland in 1985 (Awaid & Abood, 2014). Learning strategy is oriented to students, students are asked to process the problems presented by the teacher. Lie (2015) believes that pair exchange techniques give students the opportunity to engage themselves and work with others. Think-Pair

Share cooperative learning strategy gives students more opportunities to think for themselves, discuss, to help each other in groups, and to be given opportunities to share with other students. In Think-Pair-Share cooperative learning strategy, there are 3 steps involved, namely thinking, pairing and sharing. According to Bataineh (2015), the following steps are used: (1) thinking; (2) in pairs; (3) share. The first stage is thinking, at this stage the teacher asks a question or problem associated with the lesson using real activities, and asks students to use a few minutes to think for themselves. The second stage is pairing, at which point the teacher asks the students to pair up and discuss what they have gained. The third stage is sharing, at this stage the teacher asks the pairs of students to share their work during practical work with whole class and other students give feedback from their friend's performance. The stages in Think-Pair-Share cooperative learning techniques are: Thinking, the teacher asks questions or pose a task and gives the opportunity to think before the students answer the proposed submission; In pairs, the teacher asks students to answer the problem and sharing, teachers ask pair of students to present their work in front of class while other students give feedbacks for their friends' performances (Ahmed, 2016). Ifamuyiwa and Onakoya (2015) also indicate that think-pair-share takes place in three stages; individual think silently about a task presented by the teacher; individual pair up and exchange ideas about the task, pair now share their views with the whole class thereby enhancing science process skills acquisition. They maintain that think-pair-share has been demonstrated to be a powerful factor in improving students' response to questions. The Australian Catholic University (ACU, 2013) indicated that think-pair-share instructional strategy results in the development of thinking ability of students, erodes shyness, and promotes gender equality, peaceful co-existence and students' involvement in activities resulting into skills acquisition. Bamiro (2015) maintain that think-pair-share instructional strategy is found to be suitable for large class size that characterizes the Nigerian public secondary schools. In this study, gender was used as a moderating variable to find out whether or not, Jigsaw II and Think-Pair-Share instructional strategies will have effect on students' acquisition of science process skills in practical Biology gender wise.

Gender disparity and inequality abound in all facets of education and even the society. According to Agu and Samuel (2018) and Nwosu (2011), gender crisis has manifested in the Nigeria education system like in most African countries indicating under representation and marginalization and thereby resulting in poor performance of females as a group compared to males. Studies in Nigeria found that gender was a significant predictor of student's choice of science subject, they found that males choose science more often than females, especially the physical sciences while females on the other hand choose the aspects of science that relate to life and home makings. This is due

to cultural beliefs which create a 'mental spectrum' about which occupation suits for males and which are more appropriate for females.

The effect of gender on students' acquisition of science process skills has been a global concern to science educators and researchers. However, there is no agreement among researchers on the outcomes of studies on gender effect. Whereas some researcher found a significant difference on the science process skills acquisition of male and female students (Omiko, 2013; Nweze, 2017), others found no significant difference in the male and female acquisition of science process skills (Adekunle, 2015). All these show that disparity exists on the process skills acquisition in Biology among male and female but Etukudo (2014) emphasizes that this depends largely on the instructional strategy used. The search for instructional strategy that can balance the inequality which provides a gap for the study in science process skills acquisition in Biology cannot be over emphasized. It is against this background that the researcher investigated the effect of Jigsaw II and Think-Pair-Share on secondary school students' acquisition of science process skills, retention and interest in Biology.

Statement of the Problem

The performance of students in Biology in Nigerian schools according to research findings has not been encouraging and this is resulting to unnecessary change of courses among postgraduate students of Biology. Research findings revealed that most Biology students cannot use concepts and skills they seem to have mastered in solving real world problems given to them. Most of these students cannot relate what they seem to know to real life situation. These have been partly attributed to students' interest towards learning of abstract concepts as well as ineffective method of teaching Biology that would enhance manipulative and psychomotor skills development as some of the strongest factors militating against the non-acquisition of science process skills resulting into poor performance among Biology students in Nigerian schools. Poor performance of students in Biology practical examinations vis-à-vis the methods Biology teachers adopt have been an issue in Biology education for a very long time now.

Jigsaw II and Think-Pair-Share instructional strategies has been suggested as a solution to wide array of educational problems. It is often cited as a means of emphasizing thinking, eroding shyness, enhancing social interaction and manipulative skills as well as increasing higher-order learning, self-reliability among students, a way to prepare students develop interest and to work in group and as well on their own before seeking interferences from others. How many of these claims have been justified? What effect can Jigsaw II and Think-Pair-Share have on acquisition of science process skills among Biology students in the Nigerian secondary schools? Why is it that students are performing poorly in Biology practical examinations year-in year-out despite these

methods that have been suggested and probably used by Biology teachers? Which of these methods (Jigsaw II and Think-Pair-Share) is more effective on student's acquisition of science process skills in Biology? Thus, the study sought to determine if exposure to Jigsaw II and Think-Pair-Share Instructional Strategies will as well enhance acquisition of science process skills in Biology among senior secondary school students in Nasarawa west senatorial district of Nasarawa State.

Research Questions

The following research questions guided the study:

1. What are the process skills acquisition mean scores of SSI students taught Practical Biology using Jigsaw II, Think-Pair-Share and Conventional Methods?
2. What are the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Jigsaw II instructional strategy?
3. What are the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Think-Pair-Share instructional strategy?

Statement of Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

Ho_1: There is no significant difference in the process skills acquisition mean scores of SSI students taught Practical Biology using Jigsaw II, Think-Pair-Share and Conventional Methods.

Ho_2: There is no significant difference in the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Jigsaw II instructional strategy.

Ho_3: There is no significant difference in the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Think-Pair-Share instructional strategy.

Methodology

The study adopted a quasi-experimental pretest-posttest control group design. The population for this study comprised 13,426 (7047 Male and 6379 Female) SSI students in West Senatorial District, Nasarawa State, Nigeria. A sample of 112 SSI student were drawn from three co-educational public senior secondary schools in West Senatorial Districts of Nasarawa State. A multi-stage sampling technique was used and arrived at one intact class each from the schools. The schools were randomly assigned to two treatment groups; Jigsaw II and Think-Pair-Share Instructional Strategies, and Control Group. An instrument titled Practical Biology Process Skills Acquisition Test (PBIPSAT) was developed by the researchers, validated and used for data collection. PBIPSAT

consists of 25 Multiple Choice Items (MCI) and 5 Practical Skills Test (PST) for assessing students' acquisition of science process skills of experimentation, observation, identification, reporting and inferences. PBIPSAT's reliability coefficient (internal consistency) of 0.85 was determined using split half methods. Mean and Standard Deviation was used to analyze the data while the null hypotheses were tested at 0.05 alpha level using Analysis of Co-variance (ANCOVA). A post hoc Analysis using Bonferroni test was done to determine the direction of superiority of means by Pair-wise Comparison based on the estimated marginal means.

Results/Data Presentation

Research Question One

What are the process skills acquisition mean scores of SSI students taught Practical Biology using Jigsaw II, Think-Pair-Share and Conventional Methods?

Table 2

Mean Scores and Standard Deviations in PBIPSAT of Students in the Experimental and Control Groups

Teaching Methods	Test	N	Mean	S.D
Jigsaw II	Pretest	42	25.43	4.99
	Posttest	42	34.45	5.89
Think-Pair-Share	Pretest	32	25.34	4.74
	Posttest	32	40.19	5.81
Convention Method	Pretest	38	24.71	3.99
	Posttest	38	26.89	4.13

From the Table 2, the groups show significant increase in posttest scores when compared to pretest. the highest mean score (40.19) is recorded by the TPSIS group followed by JIIIS (34.45) and conventional method (26.89) last which implies that students taught photosynthesis using the TPSIS had a higher process skills acquisition than other instructional strategies.

Hypothesis One

Ho_1: There is no significant difference in the process skills acquisition mean scores of SSI students taught Practical Biology using Jigsaw II, Think-Pair-Share and Conventional Methods.

Table 3

One-Way ANCOVA Results on Process Skills Mean Scores in PBIPSAT.

Source	Type III sum of squares	df	Mean Square	F	Sig	Result
Corrected Model	4608.131	3	1536.044	106.411	0.000	S
Intercept	673.698	1	673.698	46.671	0.000	S

Pretreatment test	1573.067	1	1573.067	108.976	0.000	S
Group	2226.352	2	1113.176	77.117	0.000	S
Error	1558.976	108	14.435			
Total	132530.000	112	14.435			
Corrected total	6167.107	111				

S = Significant at P < 0.005

Table 3 shows the summary of the one-way ANCOVA results on students' process skills acquisition mean scores of PBIPSAT in the Experiment and Control groups. It revealed that the noted difference between the process skills mean scores of the students taught using J2IS, TPSIS and CM was significant at 0.05 alpha levels. This is from the fact that $F_{(2,108)} = 77.117$ and, $P=0.000 < \propto = 0.05$. The null hypothesis was therefore rejected, indicating that there is significant difference in the process skills means scores of students' taught J2IS, TPSIS and CM. A post hoc Analysis using Bonferroni test carried out to determine the direction of superiority of means by Pair-wise Comparison based on the estimated marginal means, the result is shown in Table 4.

Table 4
Bonferroni Test Analysis for Pair-wise Comparison of Means for J2IS, TPSIS and CM

(I)	(J) (I-J)	Mean Difference	Std Error	Sig.	95% Confidence interval for Difference	
					Lower Bound	Upper Bound
TPSIS JIS		-5.805	0.892	0.000	1.027	6.151
	CM	5.676	0.866	0.000	11.906	16.616
TPSIS	JIIIS	5.805	0.892	0.000	-6.151	-1.027
	CM	11.481	0.925	0.000	8.214	13.130
CM	JIIIS	-5.676	0.866	0.000	16.616	-11.960
	TPSIS	-11.481	0.925	0.000	13.130	-8.214_

Based on the estimated marginal means, Table 4 reveals the following mean difference between groups: J2IS and TPSIS have mean difference of 5.805, $P = 0.892 < \propto = 0.05$. J2IS and CM have mean difference of 5.676, $P = 0.866 < \propto 0.05$, while TPSIS and CM have 11.481, $P = 0.925 < \propto 0.05$. Even though both mean differences are significant at 0.05 levels which rejected the hypotheses, the results of this test indicate that TPSIS and J2IS methods were more effective in the acquisition of science process skills among Biology students.

Research Question Two
What are the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Jigsaw II instructional strategy?

Table 5
Mean Scores and Standard Deviations in PBIPSAT of Male and Female Students in the Experimental Group 1 (JIIIS)

Gender	Test	N	Mean	S.D	
Male	Pretest	22	26.55	4.45	
	Posttest	22	34.77	6.21	
Female	Pretest	20	25.43	5.27	
	Posttest	20	34.45	5.66	

From Table 5, it could be seen that the mean scores of the male students taught with Jigsaw II instructional strategy was 26.55 and 34.77 in pretest and posttest respectively and standard deviation of 4.45 and 6.21 in that order. For the female students, it was observed that they had the mean scores of 25.43 and 34.45 in pretest and posttest, standard deviations of 5.27 and 5.66 in that order. This result indicates that the male posttest means scores is higher than that of the female.

Hypothesis Two
Ho_2: There is no significant difference in the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Jigsaw II instructional strategy.

Table 6
Results of ANCOVA on Male and Female Students Process Skills Mean Scores in JIIIS.

Source	Type III sum of squares	df	Mean Square	F	Sig	Result
Corrected Model	743.533	2	371.766	21.357	0.000	S
Intercept	215.205	1	215.205	12.363	0.001	S
Pretest	738.791	1	738.791	42.442	0.000	S
Gender	18.878	1	18.878	1.085	0.304	S
Error	678.872	39	17.407			
Total	51275.000	42				
Corrected total	1422.405	41				

S = Significant at P < 0.005

Table 6 shows the summary of the one-way ANCOVA on male and female students' process skills acquisition mean scores in J2IS. The results in Table 4.5 reveals that the

noted difference between the mean process skills scores of male and female students taught with Jigsaw II Instructional Strategy was not significant at 0.05 alpha level. This is from the fact $F_{(1, 39)} = 1.085$ and $P = 0.304 > \propto = 0.05$. The null hypothesis is therefore not rejected showing that there is no significant difference in the process skills mean scores of male and female students who were exposed to J2IS.

Research Question Three

What are the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Think-Pair-Share instructional strategy?

Table 7

Mean Scores and Standard Deviations in PBIPSAT of Male and Female Students in the Experimental Group 2 (TPSIS)

Gender	Test	N	Mean	SD	
Male	Pretest	18	24.44	4.05	
	Posttest	18	39.94	4.15	
Female	Pretest	14	26.50	5.43	
	Posttest	14	40.50	7.60	

Table 7 reveals that the male students taught with Think-Pair-Share instructional strategy possess mean scores of 24.44 and 39.94 in the pretest and posttest respectively and standard deviations of 4.15 and 5.43 in the process skills acquisition test. For the female students, they had mean scores of 26.50 and 40.50 in the pretest and posttest, and standard deviations of 5.43 and 7.60.

Hypothesis Three

Ho_3: There is no significant difference in the process skills acquisition mean scores of male and female SSI students taught Practical Biology using Think-Pair-Share instructional strategy.

Table 8

Results of ANCOVA on Male and Female Students Process Skills Mean Scores in TPSIS.

Source	Type III sum of squares	df	Mean Square	F	Sig	Result
Corrected Model	344.639	2	172.320	7.116	0.003	S
Intercept	474.273	1	474.273	19.586	0.000	S
Pretest	342.209	1	342.209	14.132	0.001	S

Gender	6.380	1	6.380	0.263	0.612	S
Error	702.236	29	24.215			
Total	51275.000	32				
Corrected total	1422.405	31				

S = Significant at P < 0.005

Table 8 shows the summary of the one-way ANCOVA on male and female students' process skills mean scores in TPSIS. It reveals that the noted difference between the mean process skills scores of male and female students taught with Think Pair Share Instructional Strategy was not significant at 0.05 alpha level. This is from the fact $F_{(1, 39)} = 0.263$ and $P = 0.612 > \propto = 0.05$. The null hypothesis is therefore not rejected showing that there is no significant difference in the process skills mean scores of male and female students who were exposed to TPSIS.

Discussion of the Findings

The findings of this study revealed that Think-Pair-Share instructional strategy had significant effect on student's acquisition science process skills. Hence, students who were taught using Think-Pair-Share method achieved better than those taught using Jigsaw II method and significantly better than those taught using conventional method. The enhanced process skills acquired were because each member was allowed to think about a task individually before pairing up to form groups. Each member of a group was responsible for helping group mates resulting into exchange of ideas as they learn by interaction so as to refine the ideas that such an individual had. This showed that Think-Pair-Share method is more effective among the teaching methods in the study. A post hoc Analysis using Bonferroni test was done to determine the direction of superiority of means by Pair-wise Comparison based on the estimated marginal means, the results show the following mean difference between groups: J2IS and TPSIS, J2IS and CM and TPSIS and CM. Even though both mean differences are significant at 0.05 levels which rejected the hypotheses, the results of this test indicate that TPSIS is more effective in the acquisition of science process skills among students when taught Practical Biology than Jigsaw II Instructional Strategy.

This result confirms the previous research findings of Khaji (2010), Gafoor (2012), Awaid and Abood (2014), Bataineh, (2015), Bamiro (2015), Salman (2015), Al-Sultani (2015), Saleh and Ibrahin (2015), Ahmad (2016), Eze and Obiekwe (2017), Umar (2017) and Ribhi (2017), which reported that students taught with think-pair-share instructional strategy on academic achievement in science have higher mean scores than those taught with conventional method. This is in agreement with the findings of

Nwagbo and Chikelu (2011) who found that students achieved better when taught Biology using practical activities on students' acquisition of science process skills.

In respect to gender, the process skills mean scores of male and female students exposed to jigsaw ii and think-pair-share instructional strategy shown no significant difference. Even though there is a slight difference in the process skills mean scores in favour of male in jigsaw II and a slight difference in the process skills mean scores in favour of female in think-pair-share, the results showed that the noted difference between the process skills acquisition mean scores of male and female students in the two instructional strategies is not significant at 0.05 alpha level. This is in agreement with the findings of Nwagbo and Chikelu (2011), Mbacho and Githua (2013), Gambari and Yusuf (2013), Mbacho and Changeinyo (2013) and Qaseem (2017) who found no significant difference among male and female with respect to methods and science achievement. However, the study is in disagreement with that of Hesbon, Mark and Samuel (2014); Eze and Obiekwe (2017) and Megwa (2019) who reported that disparity exist in the science achievement among males and females.

Conclusion

The findings of this shows that the utilization of Jigsaw II, Think-Pair-Share instructional strategies can enhance the acquisition of science process skills more than the conventional method in the favour of Think-Pair-Share instructional strategy and are gender friendly.

Recommendations

Based on the findings and conclusions arrived, the following recommendations are made:

1. The cooperative learning strategies used in this study are highly recommended to be used in teaching Practical Biology in senior secondary schools, seeing that they have capacity to improve acquisition of science process skills.
2. Secondary school Biology teachers should be sensitized on the way of involving students in the use of these strategies to enable them perform better in Biology by way of conferences, paper presentations, seminars, workshops by various association or organization like Science Teachers Association of Nigeria (STAN), National Association of Science, Humanities Education Research (NASHER), science educators of various institutions, state ministries of education and Federal Ministry Education (FME).

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