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CALL FOR PAPERS
INTERNATIONAL JOURNAL OF CONTEMPORARY ISSUES IN INTEGRATED SCIENCE EDUCATION (IJCIISE)

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EDITORIAL

Dear Readers,

We are excited to announce the launch of International Journal of Contemporary Issues in Integrated Science Education (IJCIISE). This Association Integrated Science Educators' Association of Nigeria (ISEAN) play a vital role in promoting scientific advancement, supporting science education, informing science policy, recognizing science excellence and fostering community engagement. The desire to float this journal was borne out of the passion to organize a yearly conference of Integrated Science by the Integrated Science Educators' Association of Nigeria, of which selected scholarly articles will be published after a thorough review. The journal dedicated to advancing knowledge and fostering dialogue within. Our mission is to publish high-quality research, innovative ideas, and critical analyses that contribute to the understanding and development of Integrated Science. At IJCIISE, we believe in the power of interdisciplinary collaboration and inclusivity. We welcome contributions from scholars, practitioners, and thought leaders worldwide, providing a space for diverse perspectives and groundbreaking work. As we embark on this journey, we invite you to submit your research, engage with our content, and join us in creating a vibrant academic community. Together, we can push the boundaries of knowledge and inspire future generations. Thank you for your support as we launch this exciting new endeavour.

This edition moves around issues that border on **"Enhancing Quality Assurance in Integrated Science in Nigeria."** It is believed that diverse contributions from scholars and researchers expressed in this edition will provoke the understanding of issues that could foster education for societal transformations on a global scale
We look forward to your contributions!

For further information on future conference activities, visit **http://ijciise.org/index.php/ijciise**

Warm regards,
Professor O. S. Agboola
President, Integrated Science Educators' Association of Nigeria (ISEAN)

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MIND-MAPPING AND JIG-SAW INSTRUCTIONAL STRATEGIES AS PANACEA TO IMPROVING SENIOR SECONDARY SCHOOL STUDENTS' PERFORMANCE AND SKILL ACQUISITION IN AGRICULTURAL SCIENCE IN OSUN STATE, NIGERIA

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Abstract
The study investigated the effectiveness of mind mapping and jigsaw instructional strategies on Senior Secondary School (SSS) students' academic performance as well as practical skills acquisition in Agricultural Science in rural and urban areas of Osun State. The study adopted pre-test, post-test quasi experimental research design on the population of all Agricultural Science students in SSS II; using a sample of 194 students in six intact classes selected by multistage sampling procedure. The instruments for data collection were Agricultural Science Achievement Test (ASAT) and Agricultural Science Practical Skills Test (ASPST). Data collected were analysed using mean and Analysis of Covariance (ANCOVA). The results showed a significant difference in the effectiveness of the two instructional strategies on students' academic performance ($F=_{(2,190)} = 62.177$, $p <0.05$) with mind mapping instructional strategy having higher significant effect on students' academic performance ($\overline{X}=12.2063$). The results also showed a significant difference in the effectiveness of the instructional strategies on students' practical skills acquisition ($F=_{(2,190)} = 72.198$, $p <0.05$). The result finally showed no significant difference in the interaction effect of school location and the instructional strategies on students' practical skills acquisition in Agricultural Science ($F=_{(2,187)} = 0.116$, $p > 0.05$). The study concluded that mind mapping was more effective in improving the academic performance while jigsaw was more effective in improving practical skills ($\overline{X}=13.0588$).
Keywords: Mind-mapping; Jig-saw; Academic performance; Skill acquisition

Introduction

The influence of Agricultural Science on national development cannot be

overemphasized as a result of which it is on its premise that the Federal Government of Nigeria introduced the teaching and learning of Agricultural Science in her schools. Despite the significance of Agricultural Science, its impact might not have been greatly felt. Ige, Busari and Ojo (2016) stated that the attitude of students towards studying Agricultural Science is not encouraging and that this might affect students' performances in external examinations. These assertions could be attributed to a number of factors among which is mode of instruction that is basic to students' learning outcomes and that students' poor achievements have been attributed to poor method of teaching (Aladejana, 2015; Omorogbe & Ewansiha, 2013). Acquisition of vocational skills, especially in agriculture is one of the focal points of Nigeria Educational Policy which makes Agricultural Science a core subject, especially at the basic level. However, the acquisition of vocational skills may be dependent on the teachers' competence at manipulating teaching strategies employed and where the schools are located. Several studies have been conducted in and outside Nigeria to investigate the causes of students' under achievement in Agricultural Science and other science subjects. According to Adegoke (2002), the most recurring factors in all reports include inadequate teaching strategies employed by teachers.

Mind mapping is a beneficial learning tool to help students brainstorm any topic and think creatively. Mind maps are particularly helpful in the writing process and provide students with a natural way of thinking and building thoughts on a story plot or theme. Mind maps also provide teachers with insight into their students thought process regarding a specific topic. By asking students to create mind maps, demonstrating their comprehension of a concept, teachers are able to understand what a student's prior knowledge was and how well the students understand assignment or the material being taught. This is an effective way of evaluating students' understanding of the curriculum content"

According to Aronson (2015) jigsaw instructional strategy is a student-centered strategy that increases students' participation, by creating a supportive and motivating environment. The strategy incorporates reading, writing, listening, and speaking skills which are necessary in developing students' literacy. It also develops students' interpersonal skills and encourages peer collaboration. Jigsaw is a cooperative instructional strategy in which the class is divided into small groups consisting of five to six students. These small groups serve as the students' home base or "Jigsaw" groups. Students are not so reliant on listening to every word the teacher says. Instead, they enjoy a high sense of ownership and a greater trust in their peers. Teachers do not have to lecture on every detail they want students to understand. Rather, teachers can put the responsibility for learning on the student, and travel through the room offering support and insights where they are needed most (Aronson, 2015). Teachers are information providers or evaluators to monitor students to get the right answers, yet students are viewed as learners who passively receive information (Ive, 2017). According to Tukur, Nurulwahida & Madya (2018), conventional instructional strategy is a lecture technique. The methods lays emphasis on the presentation of the content rather than methodology and does not

involve the communicative method in which the learner is allowed to share his/her knowledge along with his/her team mates. Conventional teaching or traditional teaching refers to a teaching method involving instructors and students interacting in a face-to-face manner in the classroom (Yap, 2016). These instructors initiate discussions in the classroom, and focus exclusively on knowing content in textbooks and notes. In the same vein, it was reported that students find this method dull as it involves them very little in the learning process. In the conventional instructional strategy, the teacher transmits information verbally to the students, sometimes by writing on the chalkboard (Awotua-Efebo, 2003). Students listen and take notes of facts and ideas that are considered important, sometimes asking the teacher questions for clarification.

The choice of mind mapping, jigsaw and conventional instructional strategies to teach Agricultural Science by teachers may be considered as one of the major player determining the extent to which learning is accomplished in terms of students' academic performance and practical skills acquisition; taking school location into consideration.

Statement of the Problem

Performance of students in Agricultural Science in Senior School Certificate Examinations (SSCE) is worrisome despite vast instructional resources; naturally available to learn the subject. One factor that could be attributed to this performance may be linked to the use of teacher-centered instructional strategies which may not effectively implement Agricultural Science curriculum to the extent of acquiring entrepreneurial skills by the students. Student-centered learning approach is believed to be more effective in enhancing students' learning outcomes for effective implementation of the curriculum. Mind mapping which is an individualized instructional strategy and jigsaw instructional strategy which is a cooperative strategy are characteristics of most teacher activities which are recommended in Agricultural Science curriculum and these have not been maximally explored by secondary school teachers of Agricultural Science in Osun State secondary schools. Their efficacy in Agricultural Science teaching/learning irrespective of school location becomes necessary, hence this study.

Purpose of the Study

The study aimed at investigating the effectiveness of mind mapping, jigsaw and conventional instructional strategies on the learning outcomes of Senior Secondary School Students in Agricultural Science. Specifically, the objectives of the study are to:

(i) examine the effectiveness of Mind Mapping Instructional Strategy (MMIS), Jigsaw Instructional Strategy (JIS) and Conventional Instructional Strategy(CIS) on students' academic performance in Agricultural Science in Senior Secondary Schools (SSS) in Osun State;

(ii) determine the effectiveness of MMIS, JIS and CIS on students' practical skills acquisition in Agricultural Science in SSS in the study area; and

(iii) examine the interaction effect of school location (rural and urban) and MMIS, JIS and CIS on students' practical skills acquisition in Agricultural Science in SSS in the study area."

Hypotheses

The following research hypotheses were generated and tested:

H_o1: There is no significant difference in the effectiveness of Mind Mapping Instructional Strategy (MMIS), Jigsaw Instructional Strategy (JIS) and Conventional Instructional Strategy (CIS) on students 'academic performance in Agricultural Science.

H_o2: There is no significant difference in the effectiveness of MMIS, JIS and CIS on students' practical skills acquisition in Agricultural Science.

H_o3: There is no significant difference in the interaction effect of school location and MMIS, JIS and CIS on students' practical skills acquisition in Agricultural Science.

Table 1: Summary Statistics of May/June SSCE Agricultural Science Paper 3 (Practical) Results in Nigeria, 2009 – 2019

	Paper 3 (Practical Agricultural Science)	
Year	Total number of Registered Candidates	Raw Mean Scores
2009	1,050,591	31
2010	1,041,167	23
2011	1,192,571	21
2013	1,305,194	33
2014	952,983	27
2015	575,831	21
2016	484,051	28
2017	494,920	31
2018	519,151	34
2019	534,206	34

Source: WAEC Chief Examiners' Reports, 2009 - 2019

Table 2: **Summary Statistics of May/June SSCE Agricultural Science Paper 2 (Essay) Results in Nigeria, 2009 – 2019**

	Paper 2 (ESSAY)	
Year	Total number of Registered Candidates	Raw Mean Scores
2009	1,050,591	33
2010	1,041,167	29
2011	1,192,571	29
2012	1,317,865	24

Year	Paper 2 (ESSAY) Total number of Registered Candidates	Raw Mean Scores
2013	1,305,194	37
2014	952,983	38
2015	575,831	36
2016	484,051	37
2017	494,920	38
2018	519,151	39
2019	534,206	45

Source: WAEC Chief Examiners' Reports, 2009 – 2019

Table 3: **Summary Statistics of Nov./Dec. SSCE Agricultural Science Paper 3 (Practical) Results in Nigeria, 2009 - 2019**

Year	Paper 3 (Practical Agricultural Science) Total number of Registered Candidates	Raw Mean Scores
2009	189,358	16
2010	181,354	26
2011	229,891	24
2012	242,908	15
2013	181,527	23
2014	137,265	23
2015	121,796	21
2016	86,393	11
2017	61,138	27
2018	5,223	25
2019	4,612	09

Source: WAEC Chief Examiners' Reports, 2009 – 2019

Table 3: **Summary Statistics of Nov./Dec. SSCE Agricultural Science Paper 3 (Practical) Results in Nigeria, 2009 - 2019**

Year	Paper 2 (ESSAY) Total number of Registered Candidates	Raw Mean Scores
2009	189,358	12
2010	181,354	32
2011	229,891	28
2012	242,908	33
2013	181,527	31
2014	137,265	33

Year	Paper 2 (ESSAY) Total number of Registered Candidates	Raw Mean Scores
2015	121,796	33
2016	86,393	31
2017	61,138	35
2018	5,223	28
2019	4,612	19

Source: WAEC Chief Examiners' Reports, 2009 – 2019

Note: Total obtainable marks for Paper 3 (Practical Agricultural Science) = 60 marks
Total obtainable marks for Paper 2 (Essay) = 90 marks

From Table 1, it was in four years 2009, 2013, 2017 and 2018 that raw mean scores of candidates were thirty and above. This showed that it was in those years that candidates' performance was more than half of total obtainable marks of sixty. From the Table also, it was revealed that there was fluctuation in the performance of candidates as shown by the raw mean score. The Table equally indicated a downward trend in the enrollment for the paper as indicated by the total number of registered candidates. Table 2 & 3 & 4 revealed that there was no year that candidates scored as much as half of the total obtainable marks of ninety as indicated by the raw mean scores with inconsistency. The Tables indicated a general poor performance of candidates in Agricultural Science in paper 3 and paper 2, as well as in May/June and November/December examinations. Students performance in external examinations as well as low enrolment of students in Agricultural Science have been very poor and discouraging in recent past (West African Examination Council Chief Examiners' report, 2009). The Chief Examiners' reports of 2008-2012 on Agricultural Science revealed that there was no improvement in the performance of registered and tested candidates when compared with that of the preceding years. Abimbola and Balschweid (2013) observed that this situation has affected the desire to pursue Agricultural Science as a discipline in higher institutions by many candidates. Several studies that were carried out in and outside Nigeria investigating the causes of students' performance in agriculture and other science subjects have established unsatisfactory outcomes. According to Adegoke (2002), the most recurring factors in all reports include inadequate teaching strategies employed by teachers, and also Otekunrin (2014) noted that the major problems obstructing effective teaching/learning of Agricultural Science are the use of traditional methods of teaching, irregular practice by students on school farms, inadequate farm lands for practical lessons and inadequate fund to manage practical oriented Agricultural Science.

A basic theme usually placed at the center or a picture illustrating a theme is firstly used to set the composition of a mind map. Sub-branches that are related to the subject are connected to the basic theme at the center and associations among ideas are made clearly seen. At this point, words have to be used for an effective mind map and colours can be visually used as well for clarity (Riswanto & Putra, 2012).

Paxman (2011) opined that it is possible to add words, colours and visual appearances in order to help the conceptualization and contextualization of the brain's ideas with other ideas for the most effective mind mapping. Therefore, the conceptual figure can be said to be like a colourful tree, as it binds all the concepts together as shown in Figure 1.

Figure1: Diagram of a map showing the key features of mind map
Source: mindmapper.com

More spaces are allocated in this constuct to central ideas (Madu & Metu, 2010). The fact that ideas are placed in this way implies that mind maps lay emphases more on important ideas. In addition, mind maps provide opportunities to approach a problems' solution holistically, and they are considered to be a learning tool which enables both the right and left brain to work (Wycoff, 1991, cited in Somers, Passerini, Parshan, Kagas, Casal, 2014). Bashir (2011) had reported that secondary school students taught Chemistry using concept mapping achieved higher than those using lecture method. The result is in agreement with Owolabi and Oginni (2013) who found graphic organizers as a form of mind map allowing students to follow along with the lecture and build learners' understanding of each concept with the instructor.

Jigsaw is a multifunctional structure of cooperative learning and a very useful tool for trying to help students integrate knowledge and understanding from various sources and experts. Each student on the team becomes an “expert” on one topic by working with members from other teams assigned the corresponding expert topic. Upon returning to their teams, each one in turn teaches the group; and students are all assessed on all aspects of the topic. Jigsaw method is a group work method for

learning and participating in group activities (Hakkarainen, 2012); which include

Listening, Speaking, Cooperation, Reflective thinking and Creative thinking: Groups must devise new ways of approaching, teaching and presenting material.

The above steps for jigsaw instructional strategy is illustrated with Figure 2.

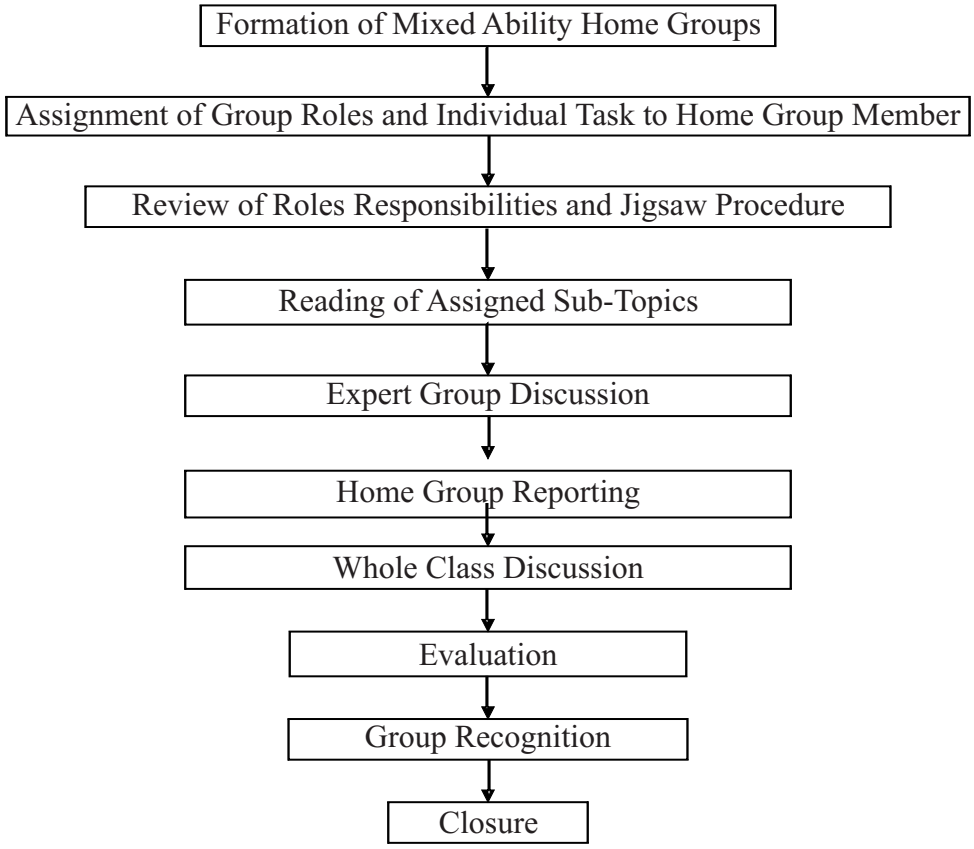


Figure 2: Flow chart of Jigsaw Cooperative instructional strategy
Source: Adapted from Chan (2004)

Conventional, teacher expository method of teaching which is teacher-centred, is the most common teaching behaviour found in schools in most Nigerian classrooms.

Dzana (2012) reported that the teacher expository teaching method is content-centred which makes teachers to be more active, more cognitive and less effective. This sort of classroom is considered as one similar to a person show with a fascinating but substantially passive audience. Students are being told (expository learning), what they need to know (Mashewari, 2013).

Nwogu (2010) found out that school location was significant in learning aspects of Mathematics and Basic Science that involve angles, with rural students

exhibiting more learning difficulties than their counterparts do. Ezeudu, Gbendu and Joshua (2014) in their study found out that the mean achievement scores of the rural and urban students taught with reflective thinking instructional technique did not differ. Results showed that school location is not a significant factor in students' achievement in Geography. Gana (2007) expressed similar view in his study on the effect of using designed visual teaching models on the learning of Mathematics and Basic Science in Junior secondary level in Niger State as he found that there was no significant difference in Mathematics and Basic Science achievement scores of students in urban and rural locations.

Several studies had been carried out to make diverse instructional strategies popular, however, a great number of such studies did not include mind mapping, jigsaw and conventional instructional strategies in improving students' learning outcomes in Agricultural Science. Hence, this study provided additional valid, useful and plausible results to the literature being investigated.

Methodology

The study adopted pretest, post-test quasi experimental research design with three independent variables (mind mapping, jigsaw and conventional instructional strategies) were used on senior secondary school students to assess their effectiveness on students' learning outcomes in terms of academic performance and practical skills acquisition in rural and urban location of school.

O_1	X_1	O_2	-	Experimental Group A (E_A)
O_4	X_2	O_5	-	Experimental Group B (E_B)
O_7	X_3	O_8	-	Experimental Group C (E_G)

O_1, O_4 and O_7 represent the pretest measures for the three experimental groups.

O_2, O_5 and O_8 represent the post-test measures for the three experimental groups.

X_1 represents treatment for experimental group A - (Mind Mapping Instructional Strategy)

X_2 represents treatment for experimental group B – (Jigsaw Instructional Strategy)

X_3 represents treatment for experimental group C – (Conventional Instructional Strategy)

The population for the study comprised all students offering Agricultural Science in senior secondary schools in Osun State with one 194 Agricultural Science students in six intact classes of Senor Secondary School Two (SSS II). Multistage sampling procedure was used in the selection of the sample for the study. One Local Government Area (LGA) was selected from each of the three Senatorial Districts in the state using simple random sampling technique. From each of the selected LGA, one urban secondary school and one rural secondary school were selected using simple random sampling technique. From each selected secondary school, an intact class of SSS II students was selected through simple random sampling technique. Each intact class from the selected schools in urban area was randomly assigned to three experimental groups. Experimental group A was taught using mind mapping,

experimental group B was taught using jigsaw, and experimental group C was taught using conventional instructional strategy. Also each intact class from the selected schools in rural area was randomly assigned to three experimental groups. Experimental group A was taught using mind mapping, experimental group B was taught using jigsaw while experimental group C was taught using conventional instructional strategy.

Two instruments were used for data collection which included Agricultural Science Achievement Test (ASAT) and Agricultural Science Practical skills Test (ASPST).

Agricultural Science Achievement Test (ASAT) consisted 25-items multiple choice questions with four options and ASAT served as pretest to ascertain equivalence ability of the subject and also served as post-test to find out the effectiveness of the treatments on students' academic performance. The test items were extracted from Senior Secondary Certificate Examination (SSCE) past questions conducted by the West African Examinations Council (WAEC) and National Examination Council (NECO).

Agricultural Science Practical Skills Test (ASPST) consisted 20- items multiple choice questions with four options and ASPST served as pretest to ascertain the level of students' ability in practical skills and also served as post-test to assess the effectiveness of the treatments on students' practical skills acquisition. The test items were extracted from Senior Secondary Certificate Examination (SSCE) past questions conducted by the West African Examinations Council (WAEC) and National Examination Council (NECO).

The instruments were validated and reliability coefficient was calculated. Agricultural Science Achievement Test (ASAT) is 0.75 and that of Agricultural Science Practical Skills Test (ASPST) is 0.73. Kuder Richardson formula 20 (KR 20) was used to calculate both instruments.

Treatments commenced the second week after the administration of pre-test in the first week in all the schools. Topics taught in each schools are: soil types/properties of soil, cultural practices, propagation of crops, crop pests and classification of feeds.

After the treatments, students were post-tested to determine the effectiveness of the three instructional strategies on students' academic performance and practical skills acquisition. All the tests scripts of the students used in the study were marked by the researchers and scores were kept as records for the purpose of data analysis. Data collected were analysed using descriptive and inferential statistics.

Results

Hypothesis Testing

Hypothesis One: There is no significant difference in the effectiveness of Mind Mapping Instructional Strategy (MMIS), Jigsaw Instructional Strategy (JIS) and Conventional Instructional Strategy (CIS) on students' academic performance in

Agricultural Science.

To test this hypothesis, One-way Analysis of Covariance (ANCOVA) was used to determine if there exist significant difference in the effects of the three strategies on students' academic performance in Agricultural Science post-test scores of the students. Firstly, measurement of the covariant was ascertained (that is before the experiment/intervention) to test whether students' academic performance in Agricultural Science before the treatment is statistically different across the independent groups (mind mapping instructional strategy, jigsaw instructional strategy and conventional instructional strategy). Table 6 shows the ANCOVA results.

Table 6: Analysis of Covariance(ANCOVA) of Post-test Scores of MMIS, JIS and CIS on Students' Academic performance in Agricultural Science

Source	Sum of Squares	df	Mean Square	F	P	Partial Eta Squared
Corrected Model	823.380[a]	3	274.460	41.643	.000	.397
Intercept	2108.667	1	2108.667	319.942	.000	.627
ASATPreTest	.800	1	.800	.121	.728	.001
Strategies	819.592	2	409.796	62.177	.000	.396
Error	1252.249	190	6.591			
Total	23192.000	194				
Corrected Total	2075.629	193				

a. R Squared = .397 (Adjusted R Squared = .387)

Table 6 showing the results of the pretest covariate revealed that the difference in the academic performance of students in the three groups were not statistically significant before the treatments were administered, ASAT-Pre-test ($F_{(2,190)}$=.121; p>0.05). The table also showed that the treatments (mind mapping, jigsaw and conventional strategies) had statistical significance ($F_{(2,190)}$=62.177; p<0.05) of the post-test scores of students' academic performance in Agricultural Science. Therefore the hypothesis that states that there is no significant difference in the effectiveness of Mind Mapping Instructional Strategy (MMIS), Jigsaw Instructional Strategy (JIS) and Conventional Instructional Strategy (CIS) on students' academic performance in Agricultural Science is rejected. The change in the students' academic performance in Agricultural Science as a result of the treatments accounted for 39.6% variation in the performance as shown in the partial eta squared value of 0.396. However, to determine the instructional strategy that accounted for the significance, pairwise comparison analysis was performed using Bonferroni because we have repeated measures (pretest and post-test) for the main effect. The results are presented in Table 7.

Table 7: Bonferroni Post-Hoc Analysis of the Performance of Students taught with the three Instructional Strategies (MMIS, JIS, CIS)

Dependent Variable: Post-test Scores for ASAT

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	P[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
Mind Mapping	Jig Saw	.690	.449	.377	-.394	1.775
	Conventional	4.709*	.458	.000	3.603	5.814
Jig Saw	Mind Mapping	-.690	.449	.377	-1.775	.394
	Conventional	4.018*	.449	.000	2.934	5.103
Conventional	Mind Mapping	-4.709*	.458	.000	-5.814	-3.603
	Jig Saw	-4.018*	.449	.000	-5.103	-2.934

Based on estimated marginal means

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

b. Adjustment for multiple comparisons: Bonferroni

The results in Table 7 shows pairwise comparison of the three instructional strategies (mind mapping, jigsaw and conventional). Performance mean difference (effect) between mind mapping and conventional instructional strategies (4.709) is higher than that of jigsaw and conventional instructional strategies (4.018). Also, performance mean difference between mind mapping and jigsaw instructional strategies is (0.690), while between jigsaw and mind mapping instructional strategies is (-0.690). This implies that mind mapping is more effective in the teaching of Agricultural Science than jigsaw and conventional strategies, as students tend to perform better using mind mapping instructional strategy.

Table 8: Descriptive Statistics: Post-test Scores for ASAT

Strategies	Mean	Std. Deviation	N
Conventional	7.4921	2.36829	63
Jig Saw	11.5147	2.28880	68
Mind Mapping	12.2063	2.99008	63
Total	10.4330	3.27941	194

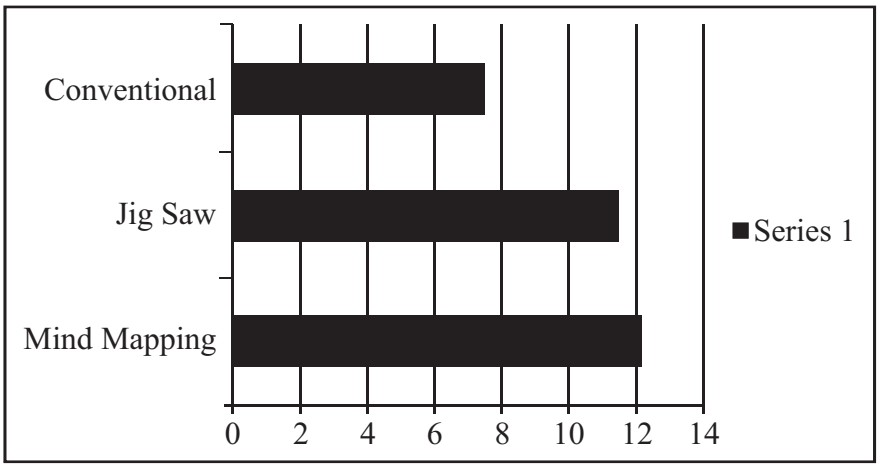


Figure 1: Mean Graphical Representation of Post Test Scores for ASAT

Hypothesis Two: There is no significant difference in the effectiveness of MIS, JIS and CIS on students' practical skills acquisition in Agricultural Science.

To test this hypothesis, scores of students on practical skills acquisition in Agricultural Science in pretest and post-test were recorded across the three groups (mind mapping, jigsaw and conventional). In the first instance, measurement of the covariant was established (that is before the experiment/intervention) to test whether students' practical skills in Agricultural Science before the treatment is statistically difference across the independent groups (mind mapping instructional strategy, jigsaw and conventional). The results are presented in Table .

Table 9: Analysis of Covariance(ANCOVA) of Students' of MMIS, JIS and CIS on Students' Practical Skills Acquisition in Agricultural Science

Source	Sum of Squares	df	Mean Square	F	P	Partial Eta Squared
Corrected Model	1164.979[a]	3	388.326	48.175	.000	.432
Intercept	2669.897	1	2669.897	331.223	.000	.635
ASATPreTest	3.244	1	3.244	.403	.527	.002
Strategies	1163.934	2	581.967	72.198	.000	.432
Error	1531.536	190	8.061			
Total	25602.000	194				
Corrected Total	2696.515	193				

a. R Squared = .432 (Adjusted R Squared = .423)

The pretest scores as covariate shows that there was no statistical difference in the practical skills acquisition of students before the treatments were administered. ($F_{(2,190)}$=.403; p>0.05). Table 9 shows the results of the treatments (mind mapping instructional strategy, jigsaw instructional strategy and conventional instructional strategies) had statistically significant effect ($F_{(2,190)}$=72.198; p<0.05) on students' practical skills acquisition in Agricultural Science. Therefore, the hypothesis that states that there is no significant difference in the effectiveness of mind mapping instructional strategy, jigsaw instructional strategy and conventional instructional strategy on students' practical skills acquisition in Agricultural Science is rejected. The change in the students' Agricultural Science practical skills acquisition as a result of the treatment accounted for 43.2% variation in the practical skills acquisition as revealed in partial eta value of .432. However, to determine the instructional strategy that accounted for the significant pairwise comparison analysis was performed using Bonferroni for the main effect. The results are presented in Table 10.

Table 10: Bonferroni PostHoc Analysis of the Three Instructional Strategies (MMIS,JIS & CIS) on Practical Skills Acquistion

Dependent Variable: Post-Test Scores for ASPST

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	P[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Mind Mapping	Jig Saw	-1.088	.496	.089	-2.287	.112
	Conventional	4.597*	.507	.000	3.371	5.822
Jig Saw	Mind Mapping	1.088	.496	.089	-.112	2.287
	Conventional	5.684*	.498	.000	4.482	6.887
Conventional	Mind Mapping	-4.597*	.507	.000	-5.822	-3.371
	Jig Saw	-5.684*	.498	.000	-6.887	-4.482

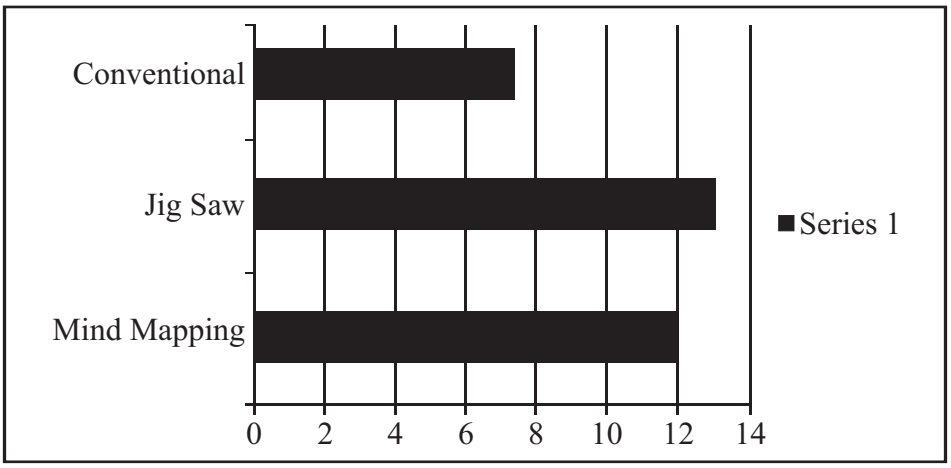
Based on estimated marginal means
*. The mean difference is significant at the .05 level.
b. Adjustment for multiple comparisons: Bonferroni.

The results in Table 10 shows pairwise comparison of the three instructional strategies (mind mapping, jigsaw and conventional). Practical skills in Agricultural Science mean difference (effect) between mind mapping and conventional instructional strategies (4.597) is lower than that of jigsaw and conventional (5.684). Also, performance mean difference between mind mapping and jigsaw instructional strategies is (-1.088), while between jigsaw and mind mapping instructional strategies is (1.088). This implies that Jigsaw is more effective in the Agricultural

Science practical skills acquisition than mind mapping and conventional instructional strategies, as students tend to perform better using jigsaw instructional strategy.

Table 11: **Descriptive Statistics: Post-Test Scores for ASPST**

Strategies	Mean	Std. Deviation	N
Conventional	7.3968	2.38638	63
Jig Saw	13.0588	2.75834	68
Mind Mapping	11.9683	3.29206	63
Total	10.8660	3.73786	194



Students' Achievement Test Scores

Figure 1: Mean Graphical Representation of Post Test Scores for ASAT

Hypothesis Three: There is no significant difference in the interaction effect of school location (urban and rural) and the three instructional strategies (MIS, JIS and CIS) on students' practical skills acquisition in Agricultural Science.

To test this hypothesis, students' scores on practical skills acquisition in Agricultural Science for pretest and post-test were recorded in SPSS interface across three groups for urban and rural schools used for the study. To establish interaction effect, Analysis of Covariance was performed as shown in Table 12.

Table 12: Analysis of Covariance (ANCOVA) on the interaction effects of school location (and rural) & the three instructional strategies (MIS, JIS and CIS) on students' practical skills acquisition in Agricultural Science

Dependent Variable: Post-Test Scores for ASAPST

Source	Type III Sum of Squares	df	Mean Square	F	P	Partial Eta Squared	Noncent. Parameter	Observed Powerb
Corrected Model	1168.688a	6	194.781	23.840	.000	.433	143.043	1.000
Intercept	2650.268	1	2650.268	324.382	.000	.634	324.382	1.000
Location	.948	1	.948	.116	.734	.001	.116	.063
Strategies	1070.681	2	535.341	65.524	.000	.412	131.047	1.000
Location * Strategies	2.739	2	1.370	.168	.846	.002	.335	.076
Error	1527.828	187	8.170					
Total	25602.000	194						
Corrected Total	2696.515	193						

a. R Squared = .433 (Adjusted R Squared = .415)
b. Computed using alpha = .05

Table 12 shows the results of the post-test scores of students' practical skills acquisition in Agricultural Science with reference to the interaction effect between location (urban and rural) and instructional strategies (mind mapping, jigsaw and conventional). It shows that students' practical skills acquisition in Agricultural Science is not statistically ($F_{(2,187)}$=0.116; p>0.05) affected by location of the schools. Therefore the hypothesis that states that there is no significant difference in the interaction effect of school location (urban and rural) and mind mapping instructional strategy, jigsaw instructional strategy and conventional instructional strategy on students' practical skills acquisition in Agricultural Science is not rejected. The results further show that there was no statistical significant interaction of school location (urban and rural) and groups (mind mapping, jigsaw and conventional instructional strategies) on students' practical skills acquisition in Agricultural Science as treatment accounted for 0.2% variation in the post-test scores of students as revealed in the partial eta score of .002. This implies that the effectiveness of the three strategies (mind mapping, jigsaw and conventional) is not affected by the interaction between school location (urban and rural).

Table 13: Descriptive Statistics on Students' Practical Skills Acquisition Based on Location (Urban & Rural) and Instructional Strategies(MMIS, JIS & CIS) in Agricultural Science

Dependent Variable: Post-Test Scores for ASAPST

Location	Groups	Mean	Std. Deviation	N
Urban	Mind Mapping	12.158	3.0626	38
	Jig Saw	13.095	2.6853	42
	Conventional	7.350	2.0946	40
	Total	10.883	3.6442	120
Rural	Mind Mapping	11.680	3.6597	25
	Jig Saw	13.000	2.9258	26
	Conventional	7.478	2.8742	23
	Total	10.838	3.9100	74
Total	Mind Mapping	11.968	3.2921	63
	Jig Saw	13.059	2.7583	68
	Conventional	7.397	2.3864	63
	Total	10.866	3.7379	194

Table 13 shows the mean and standard deviation for each of the groups across urban and rural schools post-test scores for students' practical skills acquisition in Agricultural Science. The jigsaw has mean (13.095) score higher than mind mapping mean (12.158) and that of conventional mean (7.350) in urban schools. In the same manner, jigsaw has mean (13.000) score higher than mind mapping mean (11.680) and that of conventional mean (7.478) in rural schools.

Discussion of Findings

Results of the study revealed that there was significant difference in effectiveness of mind mapping and jigsaw instructional strategies on academic performance of senior secondary school students in Agricultural Science. Students that were taught using these strategies performed better academically than students exposed to conventional instructional strategy. The study further indicated the amount of effect each of the strategies had on student's academic performance in Agricultural Science. The performance mean difference between mind mapping and jigsaw instructional strategies is 0.690. This implies that mind mapping instructional strategy is more effective in teaching Agricultural Science than jigsaw and conventional instructional strategies with jigsaw instructional strategy more effective than conventional instructional strategy as students tend to perform better using mind mapping instructional strategy. This result corroborates the findings of Omorogbe and Ewansiha (2013) which reported that students performed better when they are taught with the appropriate strategy that is effective, innovative and learned-centered. The result of the study on mind mapping is in line with the findings of

Oluwatosin and Bello (2015) when they observed that mind mapping has the highest effect on improvement of students' performance in Physics, followed by Mastery Learning Approach and then the conventional method. Additionally, result of the effect of jigsaw on students' academic performance in senior secondary schools in Agricultural Science supports the findings of Achor and Musa (2014) which indicated that jigsaw learning strategies facilitated learning of Biology in secondary schools. This result further corroborates the findings of Adesoji and Ibraheem (2009) which showed that students exposed to the mind-mapping instructional strategy performed well than students taught with the conventional learning strategy in Mathematics. This was further supported by Comek, Akinoglu, Elmaci and Gundogdu (2016) which asserted that one of the techniques that can be used and applied by the teacher is the mind mapping instructional strategy to improve the learning outcomes of students in any subject. The result obtained is in accordance with those of Adodo (2013), Jubrin Abdullahi, Zayuni and Abdullahi (2012) and Onyishi (2009) in their separate studies revealed that mind-mapping strategy helped to improve students' performance in sciences.

Furthermore, the study found out that there is significant effect of jigsaw and mind mapping instructional strategies on students' practical skills acquisition in Agricultural Science. The change in students' practical skills acquisition in Agricultural Science as a result of the treatments accounted for 43.2% variation in the practical skills test. Students that were exposed to jigsaw and mind mapping instructional strategies had better performance in practical skills acquisition in Agricultural Science than students taught with conventional instructional strategy. The study further revealed the amount of effect each of the strategies had on students' practical skills acquisition in Agricultural Science. The performance mean difference between jigsaw and mind mapping instructional strategies is 1.088. This implies that jigsaw instructional strategy is more effective in practical skills acquisition in Agricultural Science than mind mapping and conventional instructional strategies. This result is in agreement the earlier findings of Timayi, Bolaji and Kajuru (2015) which revealed a significant difference in favour of students exposed to jigsaw instructional strategies. The result is also in support with what Naomi and Githua (2013) reported in their study that learners who were taught using jigsaw cooperative learning strategy performed well than those who received their lesson using conventional learning method. The result of the study also corroborates the findings of Zvezdan, Sonja, Branka, Maja and Olivera (2019) which observed that mind mapping instructional strategy has the potentiality of improving the academic performance of students.

Finally, the study found out that there is no significant effect of students' practical skills acquisition and school location (rural and urban) in Agricultural Science. Further result of the study revealed that there is no significant interaction effect of school location (urban and rural) and instructional strategies (mind mapping, jigsaw and conventional) on students' practical skills acquisition in Agricultural Science as treatments accounted for 0.2% variation in the post-stest

scores of students. This implies that the effectiveness of the three instructional strategies (mind mapping, jigsaw and conventional) is not affected by the interaction between school location (urban and rural) and group membership of students. This finding is in agreement with Essien (2017) who reported that school location has no significant influence on students' academic achievement in social studies. This result is also in support of Kolawole and Popoola (2011) who in their findings indicated that the mean performance of students from urban and rural locations in Mathematics are not significantly different. Furthermore, the findings of this study agrees with Ezeudu, Gbendu and Joshua (2014) which observed that school location is not a significant factor in students' achievement in Geography and that the mean achievement of the rural and urban students' taught with reflective instructional technique did not differ.

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