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EFFECT OF METACOGNITION APPROACH ON AGRICULTURAL SCIENCE ACHIEVEMENT OF SENIOR SECONDARY STUDENTS IN NASARAWA EGGON LOCAL GOVERNMENT, NASARAWA STATE, NIGERIA

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ABSTRACT

Students skills secondary schools such as self-awareness, self-monitoring, self-reflection, and self-regulation, all of which play a crucial role in effective learning, critical thinking, and decision-making. To stimulate this, the scholars investigated the effect of Metacognition Approach (MA)on Agricultural

Introduction

At all the levels of education, educational measurement, evaluation and assessment plays significant role in quantifying learners behaviors, value categorically, technically its answered the question thus **"how much**, and **how well"** an individual learner achievement/performed after a specified educational task accordingly (Galle, 2021). The process of assigning symbols to the dimension of phenomenon in order to characterize the status of phenomenon as precisely as possible which is known as Measurement. And assessment it is the practical application of measurement and just

science achievement of senior secondary students in Nasarawa Eggon Local Government, Nasarawa State, Nigeria. Two research questions with its corresponding null hypotheses guided the study. Quasi-experimental research design involving pre-test, post-test control group was employed. The population for the study consists of all 3,343 SS II students that offering Agricultural Science and 140 students were used as sample size of the study. 50 multiple-choice items entitled "Agricultural Science Achievement Test" (ASAT) were used as an instrument for data collection. ASAT was validated and piloted, yielding a validity index of 0.87 and a reliability index of 0.87 using KR20. Data were examined using mean and standard deviation to answer research questions, while analysis of covariance (ANCOV) was employed to test the null hypotheses (Ho) at the 0.05 level of significance. The findings of this study revealed that, there was a statistically significant difference in the mean achievement scores of students taught Agricultural Science using MA and those counterparts in conventional class. Further result revealed that, there is no statistically significant interaction difference in the mean achievement scores of male and female students taught Agricultural Science using MA and those counterparts in conventional class. Based on the findings of this study, it was recommended that teachers of Agricultural Science should use Metacognition Approach to teach will expend student achievement.

Keywords: Metacognition Approach, Agricultural Science, Achievement, Students, skills

as all testing could be subsumed under assessment, so could all assessment be subsumed under measurement (Galle, Yakubu, & Abimiku, 2022). It involves collecting data with a view to making value judgment about the quality of a person, object, group or event (Galle, Sakks, & Aminu, 2018). Agriculture is the science and art of cultivating the soil, producing crops and

raising livestock that are directly or indirectly benefiting to humans. The term agriculture also includes the financing, processing, marketing and distribution of agricultural products, farm production supply and service industries, health, nutrition and food consumption the use and conservation of land and water resources, development and maintenance of recreational resources, and related economic, sociological, political, environmental and cultural characteristics of the food and fibre system which are the extremely basis of civilization (Dreyfusi, 2017).

According to Muhammad (2014), agriculture is basically practiced for the purpose of producing food and other human needs such as shelter, clothing, medicines, tools, weapons, ornaments and for the foreseeable future many more items. It is the food eaten by men, the clothing wearing, the material of homes, the gardens in vicinity, and many of human traditions and values come from agricultural segment. It is likewise practiced as a business for human needs and economic gain based on systematized body of knowledge and requires skill. Agriculture is mainly composed of six specialized branches, which are: Agronomy (deals with soil management and the growing of crops); Horticulture (deals with the cultivation of fruits, vegetables and ornamental crops); Plant protection (relates to control of insect pests and diseases of plants); Agricultural Engineering (involves knowledge of farm machines and equipment, it also deals with developing new systems and practices to address problems facing agriculture); Agricultural Economics (deals with the business end of farming); and Animal Science (basically the breeding and caring of animal for specific purposes, such as for their meat, milk and fur).

Agriculture is one of the subjects offered in junior and senior secondary schools, as a pre-vocational elective and vocational elective respectively (Federal Republic of Nigeria, FRN, 2014). The curriculum content of the secondary school level was structured to focus on three major areas: production (food production), projection (agronomy and forestry) and economics (agricultural economics and farm management). This will help students in food production and other agricultural products for themselves and their community (Nigerian Educational Research and Development

Council, NERDC, 2012). To relates the variables of the study judiciously, Metacognition refers to the process of thinking about one's own thinking or being aware of and understanding one's own cognitive processes. It involves the ability to reflect on and monitor one's thoughts, knowledge, and problem-solving strategies. Metacognition allows individuals to regulate and control their thinking and learning processes, which in turn can enhance their overall cognitive performance.

In simpler terms, metacognition involves being aware of what you know and don't know, understanding how you learn and process information, and being able to monitor and adjust your thinking strategies to improve learning and problem-solving outcomes. It includes skills such as self-awareness, self-monitoring, self-reflection, and self-regulation, all of which play a crucial role in effective learning, critical thinking, and decision-making. As can be observed in the fields of biotechnology and genetic engineering, it plays an essential role in the growth of both individuals and communities (Bena as cited in Okafor, Ajaja, & Agboghoroma, 2023). Poor academic performance on tests and exams incorporating biological ideas is a common result of the difficulty of understanding these subjects (Nwagbo & Obiekwu 2010). It's possible that this is due to ineffective classroom practices. Usman (2010) argued that the lecture-only approach currently used to teach biology in secondary schools does not allow for a logical progression of concepts. Because of the huge class sizes typical of secondary schools in Nigeria, lecturing is the primary teaching strategy utilized by science instructors.

Despite its many benefits, the lecture format has several drawbacks that might be to blame for students' lackluster performance in biology classes. Students are not put in a position of intellectual growth and agency via hands-on activities during a lecture (Bitrus, 2014). According to Olayemi (2013), all of these meta-cognitive teaching tactics aid learning by helping students make meaningful connections between their newfound information and previously established ideas. That's according to research scholars Metacognition has a major impact on students' success in biology, says Emenike (2017). This opinion is in line with that of Ayogu (2011), who

studied the impact of two metacognitive teaching strategies, Elom (2018), Uzobuike (2015) and Andrea (2013) carried out studies in chemistry, physics and biology respectively and revealed that metacognitive learning cycle can be taught to students to improve their learning in those subjects. The question now becomes "Is it possible that such result will be realizable when metacognitive learning approach could be applied in teaching Agricultural science concepts in senior secondary schools in Nasarawa Eggon Local Government of Nasarawa State, Nigeria?

etacognition is a higher level of cognition given the label metacognition by American

developmental psychologist john Flavell. Metacognition has two main components;

metacognitive knowledge and regulation. Metacognition is considered an essential component of

effective leaning, for it enables individuals to monitor and regulate their won cognitive

performance (Algazir, 2013). Similarly, Adejumo (2012) maintained that metacognitive

awareness allows one to control and self-regulate his/her thinking and learning processes and

learning outcomes. According to Stone (2011), meta-cognition, once learned, supports reflective

thinking, helps problem solving, gives responsibility and improves self-confidence for quicker

decisions for the rest of one's life. According to Ohanusi (2011), metacognition stands out with

four characteristicsMetacognition refers to the process of thinking about one's own thinking or being aware of and understanding one's own cognitive processes. It involves the ability to reflect on and monitor one's thoughts, knowledge, and problem-solving strategies. Metacognition allows individuals to regulate and control their thinking and learning processes, which in turn can enhance their overall cognitive performance.

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Consequently. conventional teaching methods (CTM) also be deemed restricted to some degree. Traditionally, classroom settings are teacher-centred where the teacher often talks at the students instead of encouraging them to interact, ask questions or make them understand and retained the concept thought in the lesson (Galle, 2021). Most classes in Nasarawa state junior secondary schools involve rote learning of Economics, where students depend on memorization without having a complete understanding of the subject. Just bypassing the tests, consisting of descriptions, matching and other forms of indicators are all that matter to complete the mathematics curriculum. Too much talking during teaching period and dictations, rote memorization and little interaction in the classroom often leave students less attentive and less engaged and prone to skipping classes and missing lessons altogether. Moreover, students in a conventional class have little opportunity to interact with their classmates or their teacher which resulted to poor achievement. Achievement describes the level of success in relation to a task that is carried out using a standardized test under planning instruction (Galle; Sabo & Kwoku, 2022).

Another factors to be considered in this study is gender. Gender is defined as the behavioral, cultural, or psychological traits typically associated with one sex. Galle, Atiku and Gado, (2019) stated that gender is a socially constructed term depicting the system of relations between males and females, and designates behaviors, attitudes, roles, status and other processes that govern the relationship among sexes in a given educational, socio-economic and political context. When discussing gender with respect to achievement in Agricultural science, it refers to the examination of the disparities, opportunities, and outcomes that exist between males and females in the field of Agricultural science. Achievement in Agricultural science can encompass various aspects, including academic performance, career advancement, leadership positions, research contributions, and overall recognition and success within the agricultural industry. The examination of gender differences in achievement in Agricultural science aims to identify and understand any imbalances or inequalities that may exist between males and females. This includes investigating factors such

as access to education and training, opportunities for career advancement, institutional biases and discrimination, social and cultural norms, and systemic barriers that may influence gender-based disparities in achievement. By examining gender disparities in achievement in Agricultural science, it becomes possible to identify and address the barriers that may hinder the full participation and success of individuals, regardless of their gender. This analysis can help create more inclusive and equitable environments, encourage greater representation and participation of women in Agricultural science, and ultimately foster a diverse and thriving agricultural sector.

Furthermore, several literatures reviews were scholarly discussed such as Okafor, Ajaja, and Agboghoroma (2023) revealed that the metacognitive approach to teaching was more effective than the traditional lecture format. Furthermore, the research indicated that while using the metacognitive teaching technique, there was no statistically significant difference in the mean accomplishment scores of male and female students (PEDDA). The study's results led to many recommendations, including the adoption of metacognitive teaching tactics by secondary school biology instructors to increase student engagement. Osuafor and Chikodili (2021) The findings of the study revealed that there was a significant difference between the mean achievement scores of students taught mathematics using metacognitive learning cycle and conventional method in favour of metacognitive learning cycle. There was no significant difference between the mean achievement scores of male and female students taught using metacognitive learning cycle. The researcher therefore recommended among others that, mathematics teachers should adopt metacognitive learning cycle in order to cognitively engage students in the learning process and help them integrate previous knowledge in the learning of new mathematical concepts. Nwankwo, Achufusi and Obikezie (2019) findings of the study showed significant effect of metaconceptual teaching approach (MTA) on students' achievement in physics. This implies that MTA is capable of enhancing students' achievement in physics. However, the result showed

no gender influence on students' achievement in physics when MTA was used as a method of instruction.

Research Questions

The following research questions guided the study.

RQ1: What is the significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)?

RQ2: What is the significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)?

Hypotheses

The following null hypotheses raised and were tested at 0.05 level of significant.

Ho1: There is no significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)

Ho2: There is no significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)

MATERIAL AND METHODS

Design

The study adopted quasi-experimental design, involved non-randomized pretest-posttest control group. The choice of this design and its significance to this study was considered suitable and non-equivalent constitute the three groups that were used for this study. The study comprised one experimental group ((MLC) and one conventional group

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(CM). The selection was done based on two senior secondary school students II. The SS II students that were taught on content/topics areas: Crop Production, Animal Production, Fisheries and Aquaculture selected from the senior secondary education curriculum for SS II.

The experimental group students were exposed to the used of MLA while the control group C students were exposed to the used of CM. This strategy, according to Steckelberg and Srinivasan (2008) allows the researchers not only to control the effects of the independent moderator variable but also to determine any differences that may be attributed to them in the study.

Population and Sample

The population for the study consists of all 3,343 senior secondary school two students (SS II) that offered Agricultural Science in Nasarawa LG, Nasarawa State, Nigeria 2022/2023 academic season. A simple 140 SS II Agricultural Science students from two senior secondary schools were selected through random sample technique. Before obtaining the sampled size, lottery method of simple random sampling technique was employed to selected sample of two senior secondary schools namely: Government Science Secondary School Nasaraw Eggon (Experimental Group), and Government Secondary School Alogani students were exposed to CM, the study used inter classes. 75 students were exposed experimental class using MLA while 65 students were exposed to conventional method using CM.

Instrument for Data Collection

For the purpose of the study, the researchers developed 50 multiple-choice items entitled "Agricultural Science Achievement Test" (ASAT) were used as an instrument for data collection. ASAT was validated and piloted, yielding a validity index of 0.87 and a reliability index of 0.87 using KR20. The reliability results of ASAT was compared with the guidelines for interpreting alpha coefficients suggested (Galle, 2021) that "$\alpha \geq 0.9$ excellent, ≥ 0.8 good, ≥ 0.7 acceptable, ≥ 0.6 questionable, ≥ 0.5 poor, ≤ 0.5unacceptable". Therefore, the results of the reliability enabled the researchers to use the

instrument for both pretest and posttest, since the correlation was considered high and significant.

Procedure for Data Collection

Three research assistants were trained by the researchers to assist in administering the instruments ASAT and teaching the topics selected for this study. The researchers' assistants were Agricultural Science teachers with sound knowledge and years of teaching experience, the researchers monitor their activities. A week training programme was organized with the research assistants. Thought, pre-test was initially conducted to know the students existing knowledge before the training. The training programme was to acquaint the research assistants with how to use MLA in the experimental group and control group CM. The following features were addressed during the training: the objectives of the strategy, topics, contents, duration, teaching' and students' activities, methods and how the test administration, scoring of tests papers were discussed and research assistants were given the opportunity to demonstrate the use of the strategies in teaching before the commencement of the treatment.

The training ensured that the teaching was comparable, applying the same teaching skills with little or no variation in their teaching effectiveness. Items for the tests lasted for one hour fifteen minutes. During the period of testing, the researchers and research assistants ensured that the students were not cheating. Test items were given to the students as a pretest for the purpose to ascertaining the prior knowledge of the students in Agricultural Science before the treatment was given to the experimental group. Students were required to encircle the correct option out of four alternatives (A, B, C, D) provided for each question on the answer sheet. After the time allocated for the test, the scripts were collected marked and scored using a marking scheme. The experimental group students were taught Agricultural Science using MLA while control group students were taught using CM covering four lessons taught within seven weeks (4 time lessons in every week).

At the end of the seven weeks of teaching, the posttest on ASAT was administered to both the two experimental and control groups. The posttest lasted for one hour, twenty minutes. The pretest and posttest results were compared to obtain the mean gain scores of the experimental and conventional groups. Means, standard deviation were used for answering research questions while analysis of covariance (ANCOVA) was used for testing hypotheses at the 0.05 level of significant. The results are presented in below tables.

RESULTS

Research Questions/Hypotheses

RQ1: What is the significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)?

Table1: Means and Standard Deviations for Students taught Agricultural Science Using MLA and those taught Using CM

Treatment Groups	No of Cases	Pre-test		Post-test		Achievement Gain
		Mean	SD	Mean	SD	
Experimental Group (MLA)	75	23.43	4.84	28.18	5.30	4.75
Conventional Group (CM)	65	21.14	4.59	23.86	4.88	2.72

Table 1 shows means and standard deviations for difference in the mean achievement scores of students taught Agricultural Science using MLA and those taught using CM. The variation in the pre-test and post-test mean scores for experimental group is 4.75 and 2.72 for Conventional group as mean achievement gains, that is (MLA=4.75>CM=2.72). This is an indication that students taught Agricultural Science using MLA achievement higher mean gain than their counterpart students in CM. Graphically, means

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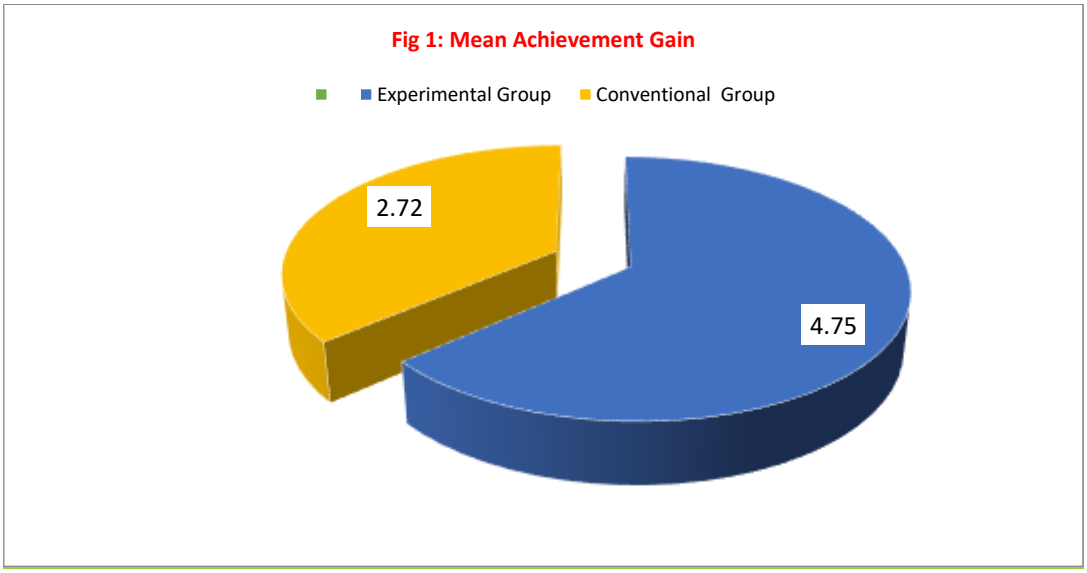
achievement gain scores for experimental (MLA) and conventional groups (CM) are presented in pie-chart fig 1 below.



Ho1: There is no significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)

Table 2: ANCOVA Results for Significant Difference between the Pretest and Posttest Mean Achievement Scores of Students Taught Agricultural Science in Experimental (MlA) and Control Group (CM)

Source of Variation	Type III Sum of Squares	Df	Mean Square	F_{cal}	P-value	Sig
Corrected model	44304.53	2	22152.27	189.028*	.000	P<0.05
Intercept	620.99	1	253.17	44.716*	.000	P<0.05
Pre-ASAT scores	6462.22	1	2594.72	116.15*	.001	P<0.05
Groups	41308.84	1	168.23	346.894*	.001	P<0.05
Error	5953.29	138	46.26			
Total	344586.00	140				

Corrected Total	50257.82	139				

The result presented in Table 2 shows the significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). At df=2, 138, F_{cal} =346.894, P-value=.001 (p<0.05). Thus, the Ho1 was not retained, hence, there is a significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). This implied that students taught Agricultural science using MLA achieved higher than their counterpart students in CM.

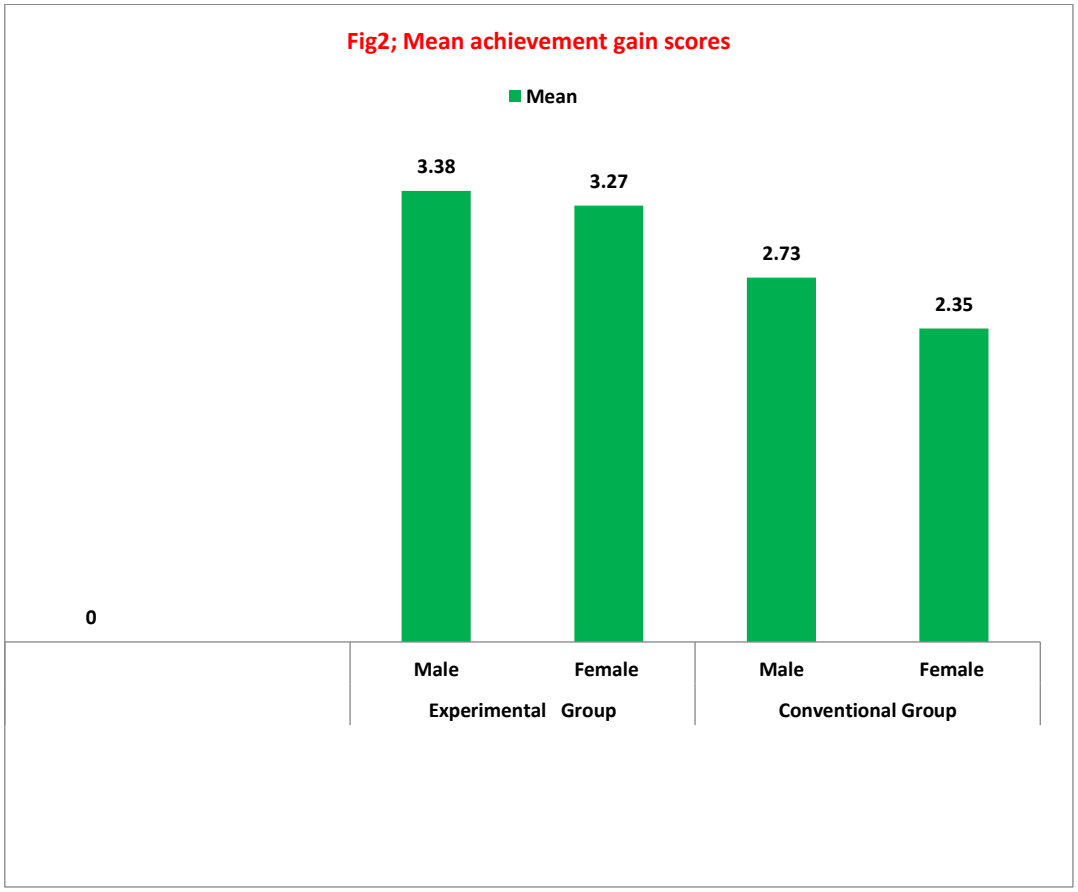
RQ2: What is the significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)?

Table 3: Means and Standard Deviations for Pretest and Posttest Mean Achievement Scores of Male and Female Students Taught Agricultural Science Using MLA and those Taught Using CM

Treatment Groups	Gender	No of Cases	Pre-test		Post-test		Mean Achievement Gain
			Mean	SD	Mean	SD	
Experimental (MLA)	Male	45	13.43	3.66	16.81	4.10	3.38
	Female	30	13.13	3.62	16.40	4.04	3.27
Conventional (CM)	Male	35	12.14	3.48	14.87	3.85	2.73
	Female	30	12.12	3.48	14.47	3.80	2.35

Table 3 shows means and standard deviations for the significant difference between the pretest and posttest mean achievement scores of male and

female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM).The variation in the pre-test and post-test mean scores of student using MLA had the highest mean achievement gain 3.38 for male and 3.27 for the female while for student using CM had 2.73 for male and 2.35 for the female respectively. This is indicated that male and female students taught Agricultural science using MLA gains higher mean achievement gains in Agricultural science related concepts than their counterpart male and female students in CM. Graphically, the means achievement gain scores for groups are presented in bar-chart fig 2.



Ho2: There is no significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM)

Table 4: ANCOVA Results for Significant Difference in Mean Scores of Male and Female Students taught Agricultural Science in Experimental and Control Group

Source of Variation	Type III Sum of Squares	Df	Mean Square	F_{cal}	P-value	Sig
Corrected model	44304.53	2	22152.27	189.028*	.001	P<0.05
Intercept	620.99	1	253.17	44.16*	.001	P<0.05
Pre-ASAT scores	6462.22	1	2594.72	116.15*	.001	P<0.05
Groups*Gender	41308.84	1	168.23	346.694*	.001	P<0.05
Error	5953.29	138	46.26			
Total	344586.00	140				
Corrected Total	50257.82	139				

The result presented in Table 4 shows significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). At df=2, 138, F_{cal} =346.694, P-value=.001 (p<0.05). This suggested a statistically significant difference in the mean achievement scores of male and female students' taught Agricultural science in experimental and then their counterpart students in conventional group. Thus, Ho2 was not retained. Hence, there is a significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). This implied that male and female students taught Agricultural science using MLA achieved higher than their counterpart students in CM.

DISCUSSION

Finding from Table 1 shows means and standard deviations for difference in the mean achievement scores of students taught Agricultural Science using

MLA and those taught using CM. The variation in the pre-test and post-test mean scores for experimental group is 4.75 and 2.72 for Conventional group as mean achievement gains, that is (MLA=4.75>CM=2.72). This is an indication that students taught Agricultural Science using MLA achievement higher mean gain than their counterpart students in CM. drawing inferences from Table 2 shows the significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). At df=2, 138, F_{cal} =346.894, P-value=.001 ($p<0.05$). Thus, the Ho1 was not retained, hence, there is a significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). This implied that students taught Agricultural science using MLA achieved higher than their counterpart students in CM. This finding is in agreement with that of Okafor, Ajaja, and Agboghoroma (2023) revealed that the metacognitive approach to teaching was more effective than the traditional lecture format. Furthermore, the research indicated that while using the metacognitive teaching technique, there was no statistically significant difference in the mean accomplishment scores of male and female students (PEDDA). The study's results led to many recommendations, including the adoption of metacognitive teaching tactics by secondary school biology instructors to increase student engagement. Osuafor and Chikodili (2021) The findings of the study revealed that there was a significant difference between the mean achievement scores of students taught mathematics using metacognitive learning cycle and conventional method in favour of metacognitive learning cycle. There was no significant difference between the mean achievement scores of male and female students taught using metacognitive learning cycle. The researcher therefore recommended among others that, mathematics teachers should adopt metacognitive learning cycle in order to cognitively engage students in the learning process and help them integrate previous knowledgein the learning of new mathematical concepts.

Finally, finding from Table 3 shows means and standard deviations for the significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM).The variation in the pre-test and post-test mean scores of student using MLA had the highest mean achievement gain 3.38 for male and 3.27 for the female while for student using CM had 2.73 for male and 2.35 for the female respectively. This is indicated that male and female students taught Agricultural science using MLA gains higher mean achievement gains in Agricultural science related concepts than their counterpart male and female students in CM. Drawing inferences from Table 4 shows significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). At df=2, 138, F_{cal} =346.694, P-value=.001 ($p<0.05$). Thus, Ho2 was not retained, hence there is a significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). This implied that male and female students taught Agricultural science using MLA achieved higher than their counterpart students in CM. This finding is in agreement with that of Nwankwo, Achufusi and Obikezie (2019) findings of the study showed significant effect of meta-conceptual teaching approach (MTA) on students' achievement in physics. This implies that MTA is capable of enhancing students' achievement in physics. However, the result showed no gender influence on students' achievement in physics when MTA was used as a method of instruction.

CONCLUSION

Based on these findings, it was concluded that there is a significant difference between the pretest and posttest mean achievement scores of students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM) and

there is a significant difference between the pretest and posttest mean achievement scores of male and female students taught Agricultural Science using metacognitive learning approach (MLA) and those taught using conventional method (CM). This implied that male and female students taught Agricultural science using MLA achieved higher than their counterpart students in CM.

Recommendations

Based on these findings, the study made the following recommendations thus:

1. Teachers of Agricultural Science should use metacognitive learning approach (MLA) to teach senior secondary school students
2. Nasarawa State Government should organize workshop of metacognition teaching approach will help in developing teaching skills and improve male and female students' achievement Agricultural Science.

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