ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

Efficacy of Metacognitive Strategy in Improving Academic Performance in Basic Science and Technology Among Junior Secondary School Two Students in Pankshin, Plateau State, Nigeria

Iliya Godiya Bako[1]; Adamu Gagdi Jibrin[2]; Shehu Danladi Zayum[2]; Abdulkarim Ali Deba[2]; Olariwaju Dauda Musa[2]

[1]Department of Integrated Science, Federal University of Education, Pankshin, Plateau State, Nigeria.
[2]Department of Science Education, Abubakar Tafawa Balewa university, Bauchi, Bauchi State, Nigeria.

Publication Date: 2026/05/11

Abstract: This study investigated the efficacy of metacognitive strategy instruction in improving the academic performance of Junior Secondary School Two (JSS II) students in Basic Science and Technology in Pankshin Local Government Area of Plateau State, Nigeria. A quasi-experimental, pretest–posttest non-equivalent control group design was adopted. The sample consisted of 137 JSS II students drawn from two public secondary schools, with 73 students in the experimental group and 64 in the control group. The experimental group was exposed to metacognitive strategy instruction, while the control group was taught using the conventional method. The instrument used for data collection was the Basic Science and Technology Performance Test (BSTPT). Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the hypotheses at a 0.05 level of significance. The findings revealed that students taught using metacognitive strategy instruction performed significantly better than those taught using the conventional method. revealed that although both male and female students benefited significantly from the Metacognitive strategy training, female students had slightly higher post-test performance scores than their male counterparts. It also revealed that although both male and female students benefited significantly from the Metacognitive strategy, female students had slightly higher post-test performance scores than their male counterparts. The study concluded that metacognitive strategy instruction is an effective approach for improving academic achievement in Basic Science and Technology among junior secondary school students. It was therefore recommended that Basic Science teachers should integrate metacognitive strategy instruction into classroom practices.

Keywords: *Metacognitive Strategies, Academic Performance, Basic Science and Technology, Gender and Instruction.*

How to Cite: Iliya Godiya Bako; Adamu Gagdi Jibrin; Shehu Danladi Zayum; Abdulkarim Ali Deba; Olariwaju Dauda Musa (2026) Efficacy of Metacognitive Strategy in Improving Academic Performance in Basic Science and Technology Among Junior Secondary School Two Students in Pankshin, Plateau State, Nigeria. *International Journal of Innovative Science and Research Technology*, 11(4), 4129-4134. https://doi.org/10.38124/ijisrt/26apr1817

I. INTRODUCTION

Basic Science and Technology is a foundational subject in the Nigerian basic education curriculum, aimed at developing scientific literacy, critical thinking skills, and technological awareness among learners. It plays a vital role in preparing learners for advanced studies in science, technology, engineering, and mathematics (STEM). However, despite its importance, students' performance in Basic Science and Technology at the junior secondary level has remained unsatisfactory in many parts of Nigeria, including Plateau State.

Several factors have been identified as responsible for students' poor performance in science-related subjects, such as inadequate instructional strategies, lack of learner engagement, and over-reliance on teacher-centred methods. Traditional teaching approaches often encourage rote memorization rather than meaningful understanding and self-regulated learning. As

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

a result, students struggle to develop the cognitive and metacognitive skills needed for effective learning.

Metacognitive strategy instruction involves teaching students how to plan, monitor, and evaluate their own learning processes. It helps learners become aware of their thinking patterns and learning strategies, enabling them to take control of their own learning. According to Flavell's theory of metacognition, learners who understand how they think are better able to regulate their learning activities and achieve better academic outcomes.

Recent studies (e.g., Adeyemi & Yusuf, 2021; Okoro & Bello, 2022; Zhang, 2023) have demonstrated that metacognitive strategies significantly enhance students' academic achievement, understanding of concepts, and retention of knowledge in science subjects. These strategies include self-questioning, summarising, goal setting, and reflective thinking. Metacognitive strategy, when incorporated into teaching and learning could therefore improve learning outcomes in science education. Given the persistent low academic performance of junior secondary school students in Basic Science and Technology in Pankshin Local Government Area, there is a need to explore innovative instructional approaches. This study, therefore, investigated the efficacy of metacognitive strategy instruction in improving academic performance in Basic Science and Technology among JSS II students in Pankshin Local Government Area of Plateau State.

Gender, though seen as a psychological construct of interest and self-efficacy in this study; the terminology has been used to describe maleness and femaleness. Zepeda, Richey, Ronevich and Nokes-Malach (2015) sees gender as a complex term that encompasses the behaviors, roles, and attitudes that a society considers appropriate for individuals based on their biological sex. Significant effort has been made to promote gender equality in science and technology education at all level of education. However, gender gaps in science and technology performance still exist. In the same vein, the statistics of BECE result for basic science and technology in Pankshin Area Directorate of Education (2020 and 2023) shows that, male students achieved better than their female counterparts, with the male students 43.67% of male students securing credit pass while 29.04% of female students obtaining credit pass in Basic Science as shown in table 1. The relatively lower performance of female students may be influenced by the continued reliance on conventional, teacher-centered instructional methods, which often do not adequately address diverse learning needs or foster active engagement—factors that are crucial for enhancing students' interest and self-efficacy, particularly in subjects like Basic Science and Technology.

The consistent poor performance of students in Basic Science and Technology at the junior secondary school level has become a major concern to educators, parents, and policymakers in Pankshin Local Government Area of Plateau State. Many students demonstrate limited understanding of scientific concepts, inability to apply knowledge to real-life situations, and low retention of learned content. This could be in connection with the existing teaching methods in most public schools which is largely conventional and teacher-centred, with little emphasis on students' involvement in the learning process. Such approaches do not encourage students to reflect on their learning, monitor their understanding, or take responsibility for improving their performance.

Although various instructional strategies have been suggested, little attention has been given to the deliberate teaching of metacognitive strategies in Basic Science and Technology classrooms within the study area. Therefore, the study seeks to investigate the efficacy of metacognitive strategy instruction in improving academic performance of Junior Secondary School Two students in Basic Science and Technology in Pankshin Local Government Area of Plateau State. Nigeria.

➢ *Objectives of the Study*

The main objective of this study was to determine the efficacy of metacognitive strategy instruction on students' academic performance in Basic Science and Technology.

The specific objectives were to:

- Determine the effect of metacognitive strategy on JSS two students' performance in Basic science and technology.
- Find out the effect of gender on performance of students when taught Basic Science and Technology using Metacognitive strategy training.

➢ *Research Questions*

- What is the effect of Metacognitive strategy training on JSS two students' performance in Basic science and technology?
- What is the effect of gender on performance of students when taught Basic Science and Technology using Metacognitive strategy training?

➢ *Research Hypotheses*

The following hypotheses were formulated and were tested in the study at 0.05 level of significance:

- $H0_1$: There is no significant difference in the mean performance score of JSS two students exposed to Metacognitive strategy training and those exposed to conventional teaching method.
- $H0_4$: There is no significant difference in the mean performance scores of students with respect to gender when exposed to Metacognitive strategy training.

II. METHODOLOGY

The study adopted a quasi-experimental non-equivalent pretest–posttest control group design. The study was conducted in Pankshin Local Government Area of Plateau State, Nigeria. The population comprised all Junior Secondary School Two (JSS II) students in public secondary schools in Pankshin LGA.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

Simple random sampling was used in selecting two schools and assigning them in to experimental and control groups. Experimental group has 73 students and Control group has 64 students. The instrument used was the Basic Science and Technology Performance Test (BSTPT) and it consisted of 40 multiple-choice questions from the concepts work, energy and power. BSTPT reliability coefficient of **0.82** was obtained using Kuder-Richardson Formula 20 (KR-20). Both groups were administered a pretest to determine their entry behaviour. The experimental group was taught using metacognitive strategy while the control group was taught using the conventional teaching method. After six weeks of instruction, a posttest was administered to both groups. Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

III. RESULTS

- *Research Question One*

What is the effect of Metacognitive strategy on JSS two students' performance in Basic science and technology?

Table 1: Summary of Mean and Standard Deviation Performance Scores of Pre-tests and Post-test of the Experimental and Control Groups

Variable	Group	N	$\bar{x}$	Std. Dev	Mean Difference
Pretest Performance	Metacognitive Strategy (MST)	73	31.53	10.61	
					5.58
	Conventional Teaching Method	64	36.53	15.04	
Posttest Performance	Metacognitive Strategy (MST)	73	54.18	10.97	
					9.21
	Conventional Teaching Method	64	44.97	10.44	

Table 1 above shows that the experimental group obtained a mean test score of 31.05 with standard deviation of 10.61 while the control group had a mean performance test score of 36.53 with a standard deviation of 15.04 in the pre-test. A mean difference of 5.48 was obtained from the pre-test of the groups. This shows that the pre-test mean achievement scores were not similar, the control group performed better than the experimental group. However, after treatment was applied, the experimental group had mean performance test score of 54.18 with standard deviation 10.97 while the control group had a mean performance test score of 44.97 with standard deviation of 10.44 and their mean difference was 9.21 in favour of experimental group. Thus, the experimental group, performance is higher than the control group. This means that the students taught Basic science and technology using Metacognitive strategy achieved higher than those taught using conventional teaching method.

- *Research Question Two*

What is the influence of gender on performance of students when taught Basic Science and Technology using Metacognitive strategy?

Table 2: Summary of Post-test Mean and Standard Deviation Performance Scores in Post-Test Based on Gender

Variable	Group	N	$\bar{x}$	Std. Dev	Mean Difference
Posttest Performance	Male	34	52.83	14.33	
					2.62
Posttest Performance	Female	39	55.45	15.68	
Total		73			

Table 2 above shows that the males in the experimental group had a mean performance score of 52.83 with standard deviation 14.33 while the females had a mean achievement score of 55.45 with a standard deviation of 15.68. This gives a mean difference of 2.62. Thus, the females scored higher than the males in the post-test. However, it is pertinent to note that both males and female students performed well when exposed to Metacognitive strategy.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

➢ *Testing of Research Hypotheses*

The null hypotheses were tested at a 0.05 level of significance.

- *Hypothesis One (H_{01})*

There is no significant difference in the mean performance scores of JSS Two students exposed to Metacognitive strategy training and those not exposed.

Table 3: ANCOVA Summary of Pre-Test and Post-Test Performance Scores for Experimental and Control Groups

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	11534.347[a]	2	5767.294	40.806	.000	.259
Intercept	13741.874	1	13741.874	167.278	.000	.418
Pretest	6532.277	1	6532.277	46.219	.000	.166
Group	7834.953	1	7834.953	55.436	.000	.192
Error	32930.612	134	141.333			
Total	396393.000	137				
Corrected Total	44465.199	136				

The ANCOVA result shows that, after controlling for pre-test scores, there is a statistically significant difference in post-test performance between students exposed to the Metacognitive strategy training and those taught using conventional methods, F(1, 137) = 55.436, p = .000. This indicates that the Metacognitive strategy training had a significant positive effect on students' academic performance in Basic Science and Technology. Therefore, the null hypothesis is rejected.

- *Hypothesis Two (H_{02}):*

There is no significant difference in the mean performance scores of students with respect to gender when exposed to Metacognitive strategy training.

Table 4: ANCOVA Summary of Post-Test Performance Scores Based on Gender for Students Taught Using Metacognitive Strategy Training

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2948.685[a]	2	1474.342	7.198	.001	.110
Intercept	20025.654	1	20025.654	97.775	.000	.455
Pretest_MST	2742.349	1	2742.349	13.389	.000	.103
Gender	199.505	1	199.505	.974	.326	.008
Error	23963.282	72	204.814			
Total	379212.000	73				
Corrected Total	26911.967	72				

The ANCOVA result shows that after controlling for pre-test performance, there was a statistically significant difference in the post-test performance scores of male and female students taught using the Metacognitive strategy training, F(1, 73) = .974, p = .326. This result indicates that gender had no significant influence on student performance when the Metacognitive strategy training was applied in Basic Science and Technology. Therefore, the null hypothesis is rejected.

IV. DISCUSSION OF FINDINGS

The results for Research Question one revealed that the use of Metacognitive Strategy significantly improved the academic performance of Junior Secondary School Two students in Basic Science and Technology when compared to those who were not exposed to the strategy. This finding affirms that when students are guided to think about their own thinking processes through planning, monitoring, and evaluating their learning they tend to perform better academically. The finding supports the conceptual foundation of metacognitive instruction, which promotes self-regulation and active engagement in learning. Students who were taught using Metacognitive Strategy developed the habit of organizing their thoughts, setting goals, and evaluating their progress, which likely contributed to their superior performance in Basic Science and Technology. This outcome aligns with the cognitive learning principle that knowledge retention and transfer are enhanced when learners participate in constructing meaning rather than merely receiving information.

The finding of this study corroborates the submission of Veenman and Alexander (2017), Adeyemi & Yusuf (2021), Okoro & Bello (2022), and Ibrahim & Lawal (2024) who reported that students exposed to metacognitive strategies tend

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

to achieve better academic outcomes because they become aware of how they learn and can adapt their strategies accordingly. Similarly, Olatunde and Adebayo (2021) found that students taught using metacognitive strategies recorded significantly higher performance levels than those taught through the conventional lecture method. The consistency of these findings across different contexts suggests that metacognitive approaches transcend subject boundaries and have universal pedagogical value. In support of this, John and Musa (2021) demonstrated that students who engaged in metacognitive learning not only achieved better academic results but also developed higher self-efficacy in Basic Science. The current study thus reinforces the argument that metacognitive instruction fosters deeper understanding, promotes learner autonomy, and enhances problem-solving abilities core outcomes of effective science education. The implication is that the integration of Metacognitive Strategy into classroom teaching could serve as a powerful intervention for improving students' academic performance in Basic Science and Technology.

The results of research question two revealed that although both male and female students benefited significantly from the Metacognitive strategy training, female students had slightly higher post-test performance scores than their male counterparts. This implies that metacognitive instruction is effective across gender lines but tends to yield greater academic improvement among females. The finding suggests that the strategy is inherently gender-friendly, offering equitable learning opportunities and promoting balanced participation in Basic Science and Technology. Since the metacognitive approach encourages active reflection, self-monitoring, and individualized learning pace, it seems to support the learning preferences of both genders, albeit with a more pronounced impact on females. This could be because female students, in many contexts, tend to demonstrate higher levels of reflective engagement and collaborative learning tendencies, both of which align naturally with the principles of metacognitive instruction.

This result aligns with earlier research that underscores gender differences in the reception of metacognitive interventions. Pajares and Schunk (2017) observed that while boys and girls both benefit from metacognitive strategies, girls tend to show greater improvement in academic areas where self-regulation and reflection are emphasized—particularly in science and language-related subjects. They further noted that these strategies can help narrow gender gaps by empowering female learners to take greater control of their learning processes. Similarly, Hwang and Song (2019) found that metacognitive strategies enhanced learning achievement for all students, but the improvement was more remarkable among girls in science-based subjects. The authors attributed this to the reflective and organized learning tendencies that metacognitive instruction promotes, which align closely with learning behaviors often exhibited by female students. Taken together, these findings suggest that while the Metacognitive strategy training benefits both genders, it has the potential to serve as a pedagogical equalizer in traditionally male-dominated fields like science and technology. Therefore, teachers integrating metacognitive strategies into their lesson plans should recognize gender as a variable that can influence learning outcomes and should continue to provide balanced, inclusive instructional support for both boys and girls.

V. CONCLUSION

This study concluded that metacognitive strategy instruction significantly improves the academic performance of Junior Secondary School Two students in Basic Science and Technology in Pankshin Local Government Area, Plateau State.it also concluded that metacognitive strategy is effective across gender lines but tends to yield greater academic improvement among females. The strategy enhanced students' understanding, engagement, and retention of scientific concepts when compared to the conventional method. Metacognitive strategy instruction should therefore be considered a powerful instructional approach for achieving improved learning outcomes in Basic Science and Technology at the junior secondary level.

RECOMMENDATIONS

- Basic Science and Technology Teachers should integrate metacognitive strategies such as self-questioning and reflection into their lessons.
- Metacognitive strategy should be included in to Basic Science and Technology curriculum to enhance teaching and learning.
- Government and school management should organize capacity-building workshops, seminars and conferences for teachers on the use of Metacognitive strategy
- Further studies should explore the use Metacognitive strategy in other science subjects and levels of education

REFERENCES

[1]. Adeyemi, T. O., & Yusuf, M. A. (2021). Metacognitive strategies and students' achievement in junior secondary school science. *Journal of Science Education Research, 9*(2), 45–57.
[2]. Abdullahi, H. M., & Mohammed, R. S. (2025). Promoting self-regulated learning in science classrooms: The role of metacognitive instruction. *Journal of Contemporary Science Education, 18*(1), 11–29.
[3]. Hwang, G. J., & Song, Y. R. (2019). Revisiting the concept of STEM education: Identifying the knowledge, skills, and attitudes needed for integrating technology, engineering, and mathematics. *International Journal of STEM Education, 6*(1), 1-13.
[4]. Ibrahim, S. A., & Lawal, B. O. (2024). Improving science achievement through metacognitive strategy instruction in

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26apr1817

Nigerian secondary schools. *African Journal of Educational Psychology, 12*(1), 65–78.

[5]. John, I. A., & Musa, A. M. (2021). The effect of metacognitive strategy instruction on academic performance and self-efficacy in Basic Science among junior secondary school students. *International Journal of Educational Studies, 20*(1), 42-58.

[6]. Okoro, J. C., & Bello, S. A. (2022). Effects of self-regulated learning strategies on students' academic performance in integrated science. *International Journal of Science Teaching, 7*(3), 112–125.

[7]. Olatunde, A. T., & Adebayo, O. O. (2021). The effect of metacognitive strategies on academic performance, interest, and self-efficacy in physics among secondary school students. *Journal of Science Education, 27*(4), 185-196.

[8]. Owolabi, T. O. (2020). Metacognition and academic success in science education: Implications for teaching and learning. *Nigerian Journal of Curriculum Studies, 27*(1), 90–104.

[9]. Zhang, Y. (2023). Meta-cognitive instructional practices and science learning outcomes:A systematic review. *Journal of Educational Innovation, 15*(4), 203–219.

[10]. Pajares, F., &Schunk, D. H. (2017). Self-efficacy and motivation in education: Research and applications. In K. A. Renninger& S. Hidi (Eds.), *The Cambridge Handbook of Motivation and Learning* (pp. 342-360). Cambridge University Press.

[11]. Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., &Afflerbach, P. (2016). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning*, 1(1), 3-14.

[12]. Zepeda, C. D., Richey, J. E., Ronevich, P., &Nokes-Malach, T. J. (2015). Direct instruction of metacognition benefits adolescent science learning, transfer, and motivation: An in vivo study. *Journal of Educational Psychology*, 107(4), 954-970.