ISSN 3027 - 0138 e- ISSN 3027 – 0863

EFFECT OF METACOGNITIVE STRATEGY ON STUDENTS' ATTITUDE AND RETENTION IN BIOLOGY AMONG PUBLIC SENIOR SECONDARY SCHOOL STUDENTS IN NIGER STATE

[1]SOLOMON MOSES, [2]CHUKWUMA DORIS IFEYINWA & [3]MOHAMMED IBRAHIM
[1,2&3]Educational Psychology Department Federal University of Education, Zaria.
solomonmoses86@gmail.com
dorisifeyinwaogamba532@gmail.com; Mohabra99@gmail.com

Abstract

This study examined how metacognitive strategy impact students' attitudes and retention in Biology among public senior secondary school students in Niger State, Nigeria. The research was guided by three objectives, and hypotheses. A quasi-experimental design, incorporating pre-test, post-test, and post-test control groups, was utilized. The study population consisted of 147,392 senior secondary students from public schools in Niger State, focusing, specifically on S.S II students. A sample of 190 students was chosen, divided into two intact classes from different schools: 98 students formed the experimental group, while 92 students comprised the control group. Data collection was conducted using two validated instruments; the Biology Attitude Questionnaire (BAQ) and the Biology Retention Test (BRT), based on WAEC standards with reliability coefficients of 0.76 and 0.78, respectively. The hypotheses were tested using Analysis of Covariance (ANCOVA). Results indicated a significant difference in Biology attitudes between the experimental and control groups (F=286.574, P=.000), showing a positive attitude in the experimental group after receiving instruction via metacognitive strategy. Additionally, there was a significant difference in Biology retention between the groups after the post-test (F=70.847, P=.000), with the experimental group demonstrating higher retention. Based on these findings, it was recommended that metacognitive strategy instruction be integrated into the Biology curriculum, and teachers be trained to model this strategy to support retention in Biology and other science subjects.

Keywords: Metacognitive Strategy, Attitude, Retention and Biology

Introduction

Biology, as a core science subject, plays a pivotal role in secondary education, laying the groundwork for students' understanding of life sciences and their applications in various fields such as medicine, environmental conservation, and biotechnology. Despite its importance, many students struggle with Biology due to its complex concepts and extensive terminology, leading to negative attitudes and poor retention of knowledge (Osman, et al 2021). These challenges are particularly pronounced among senior secondary school students in regions like Niger State, Nigeria, where educational resources and innovative teaching strategy may be limited (Abdulrahaman & Garba, 2020).

The traditional teacher-centered approach, characterized by rote memorization and passive learning, dominates Biology instruction in many Nigerian secondary schools (Ibrahim & Bello, 2021). This method often fails to engage students cognitively and affectively, resulting in low motivation and interest in the subject (Ezenwosu & Okeke, 2020). Furthermore, students' inability to connect new information with prior knowledge hinders meaningful learning and long-term retention (Olakanmi & Gumbo, 2017).

Metacognition refers to one's awareness and regulation of their cognitive processes during learning Olakanmi & Gumbo (2017). Metacognitive strategy, such as self-questioning, planning, monitoring, and evaluating one's understanding, empower students to take control of their learning experiences. This strategy is crucial for promoting self-regulated learning, which has been linked to improved academic outcomes and lifelong learning skills (Zepeda et al., 2019).

In the context of Biology education, metacognitive strategy enables students to tackle complex subjects more effectively by fostering deeper engagement and facilitating the transfer of knowledge (Dignath & Veenman, 2021). A study by Ngangurinyana and Ndayambaje (2021) demonstrated that teaching metacognitive strategy improved students' problem-solving skills and retention in biology.

Attitude toward a subject significantly influences students' motivation, engagement, and academic achievement (Neiye, et al. 2019). Positive attitudes are associated with higher levels of effort, persistence, and interest, which are essential for mastering challenging subjects like Biology (Odom & Bell, 2020). Conversely, negative attitudes can lead to disengagement and decreased performance (Kim & Pekrun, 2022).

Attitude plays a critical role in shaping students' engagement, motivation, and performance in any subject. Metacognitive strategy is closely tied to attitude; students who engage in metacognitive processes often experience increased self-efficacy and a more positive outlook on challenging subjects like Biology (Neiye, et al. 2019). Muhammed and Adamu (2022) explored the effects of metacognitive regulation on students' attitudes toward biology and found that students who used self-regulatory practices were more likely to develop a favorable attitude toward the subject. This aligns with findings from other studies indicating that metacognitive training in science education can significantly impact students' outlook and overall academic behavior (Ibikunle et al., 2022).

Retention, or the ability to recall and apply learned information over time, is a critical aspect of effective learning (Shanahan, 2020). In Biology, where concepts are often interconnected, retention ensures that foundational knowledge supports the understanding of more advanced topics (Mahler et al., 2018). Strategy that enhances both attitude and retention are therefore vital for students' success in Biology. This study is anchored in Flavell's metacognitive theory who underlines the significance of learners' awareness and control over their cognitive processes, suggesting that metacognitive strategy can enhance learning outcomes. Olakanmi & Gumbo (2017).

Numerous studies have documented the benefits of metacognitive strategy in science education. For example, Ezenwosu and Okeke (2020) found that metacognitive strategy instruction led to significant gains in students' understanding and retention of ecological concepts. A study by Okorie and Hamza (2021) showed that students who received metacognitive training had significantly higher retention rates in science subjects than those who did not. Kitsantas and Cleary (2021) Found that metacognitive strategy improved students' motivation and retention in complex subjects such as biology. More so, Muhammed and Adamu (2022) conducted an experimental study in Kaduna State, Nigeria, showing that metacognitive regulation positively impacts students' attitudes and ability to retain biological concepts.

Niger State, like many regions in Nigeria, faces educational challenges such as inadequate teaching resources, overcrowded classrooms, and insufficient teacher training (Abdulrahaman & Garba, 2020). These issues contribute to students' poor performance and negative attitudes toward subjects like Biology (Ibrahim & Bello, 2021). Implementing innovative teaching methods, such as metacognitive strategy, could address these challenges by promoting active learning and improving students' engagement and understanding.

Despite extensive research on metacognitive strategy, there is limited evidence on its specific effects on attitudes and retention among Nigerian secondary school students, especially in Biology. Most studies focus on general academic performance rather than how metacognitive strategy influence long-term retention and attitude formation. Furthermore, research targeting the unique educational settings of Niger State remains scarce. The current study seeks to address these gaps by investigating the effect of metacognitive strategy on Biology students' attitudes and retention in Niger State, Nigeria.

Objectives of the Study

The primary objective of this study is to investigate the effect of metacognitive strategy on students' attitude and retention in Biology among senior secondary school students in Niger State. The specific objectives are to examine.

1. to examine the effect of metacognitive strategy on the students' attitude towards Biology compared to those in the control group.
2. to examine the effect of metacognitive strategy on the students' retention in Biology compared to those in the control group.

Research Hypotheses

The following null hypotheses were tested

H_{01}: There is no significant effect of metacognitive strategy on students' attitude towards Biology compared to those in control group

H_{02}: There is no significant effect of metacognitive strategy on students' retention in Biology compared to those in the control group.

Methodology

The study employed quasi-experimental design with pre-test and post-test and posttest control groups. The population consisted of 57,392 senior secondary school students in public school Niger State, Nigeria. The target population are SS II students in Public Secondary schools in Niger State who offered Biology as a subject, among others. The choice of SS II students was purposive because SS II are more stable than SS1 who are newly admitted and are struggling to settle down, while SS III may be preparing for their final year exams. Thus, involving them in this study may be a distraction to their preparation for West African Senior School Certificate Examination. The sample size for the study comprised of 190 divided into two intact classes from two schools which were randomly selected using simple random sampling technique. One school for experimental and the second school as control group. The experimental group was 98 and the control group was 92. The experimental group received metacognitive strategy instruction, while the control group used conventional teaching method. Biology Attitude Questionnaire (BAQ) was used to measure students' attitudes toward Biology, Biology Retention Test (BRT) is a test designed to measure students' retention of biological concepts taught during the study. Detailed lesson plans incorporating metacognitive strategy for the experiment was developed.

Pre-tests on attitude Questionnaire (BAQ) towards Biology was administered to both experimental and control group. After then the experimental group receive the treatment on metacognitive strategy. Post-tests on attitude and retention was administered to both experimental and control group at the end of six weeks intervention. After four weeks, a delayed post-test was administered to assess retention. Data was analyzed using Analysis of Covariance (ANCOVA)

Results

H_{01}: There is no significant effect of metacognitive strategy on students' attitude towards Biology compared to those in control group

Table 1: ANCOVA test on difference in Attitude towards Biology between students in the experimental group and control group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12311.545a	2	6155.772	155.640	.000
Intercept	8167.956	1	8167.956	206.515	.000
PRETEST	893.749	1	893.749	22.597	.000
Group	11334.426	1	11334.426	286.574	.000
Error	7396.118	187	39.551		
Total	274810.000	190			
Corrected Total	19707.663	189			

a. R Squared = .625 (Adjusted R Squared = .621)

Table 1 showed that F = 286.574, df 1, p= .000 is less than the alpha level of 0.005 indicating that there is a significant difference between students in the experimental group and those in the control group on their attitude towards Biology. Therefore, the null hypothesis which state that there is no significant difference in Attitude towards Biology between students in the experimental group and control group is rejected. This finding revealed that experimental group have positive attitude towards Biology after been taught using metacognitive strategy.

H_{02}: There is no significant effect of metacognitive strategy on students' retention in Biology compared to those in the control group.

Table 2: ANCOVA test on difference in retention of Biology between students in the experimental group and control group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	11994.207a	2	5997.103	182.024	.000
Intercept	4067.421	1	4067.421	123.455	.000
Posttest	727.433	1	727.433	22.079	.000
Group	2334.174	1	2334.174	70.847	.000
Error	6161.036	187	32.947		
Total	277378.000	190			
Corrected Total	18155.242	189			

a. R Squared = .661 (Adjusted R Squared = .657)

Table 2 showed that F = 70.847, df 1, P= .000 is less than the alpha level of 0.005 also indicating that there is a significant difference between students in the experimental group and those in the control group on their retention in Biology. Therefore, the null hypothesis which state that there is no significant difference in retention of Biology concepts between students in the experimental group

and control group is rejected. This finding revealed that experimental group retained Biology concepts after been taught using metacognitive strategy.

Discussion

The study investigated the Effect of Metacognitive Strategy on Students' Attitude and Retention in Biology among public senior secondary school students in Niger State, Nigeria. The specific objectives were to determine the difference in Attitude towards Biology between students in the experimental group and control group and also to determine the difference in retention of Biology between students in the experimental group and control group.

The testing of the first hypothesis revealed that there was significant difference in Attitude towards Biology between students in the experimental group and control group (F= 286.574, P= .000) indicating that experimental group have positive attitude towards Biology after been taught using metacognitive strategy. The finding of this study aligned with the study of Muhammed and Adamu (2022) who explored the effects of metacognitive regulation on students' attitudes toward Biology and found that students who used self-regulatory practices were more likely to develop a favorable attitude toward the biology. Similarly, Ibikunle et al., (2022) asserted that that metacognitive training in science education can significantly impact students' outlook and overall academic behavior. According to Odom and Bell (2020), positive attitudes are associated with higher levels of effort, persistence, and interest, which are essential for mastering challenging subjects like Biology. Conversely, negative attitudes can lead to disengagement and decreased performance. Attitude plays a critical role in shaping students' engagement, motivation, and performance in any subject as suggested by Kim and Pekrun (2022). The current study proves that metacognitive strategy as teaching method influences positive attitude.

The second hypothesis testing revealed that there was significant difference in retention of Biology between students in the experimental group and control group after post posttest (F = 70.847, P = .000) indicating that experimental group have high retention compared to control group. The current study corresponds with the study of Okorie and Hamza (2021) which revealed that students who received metacognitive training had significantly higher retention rates in science subjects than those who did not. Additionally, Kitsantas and Cleary (2021) found that metacognitive strategy improved students' motivation and retention in complex subjects such as biology. Muhammed and Adamu (2022) also asserted after conducting an experimental study in Kaduna State, Nigeria, showing that metacognitive regulation positively impacts students' attitudes and ability to retain biological concepts.

The current study has proven that metacognitive strategy influence students' attitude and retention towards Biology in Public schools, Niger state as other studies have also suggested.

Conclusion

The study concludes that significant difference in Attitude towards Biology exists between students in the experimental group and control group indicating that experimental group have positive attitude towards Biology after been taught using metacognitive strategy secondly, significant difference in retention of Biology also exists between students in the experimental group and control group after post posttest indicating that experimental group have high retention compared to control group.

Recommendations

Based on the findings, it was recommended that

1. Government should incorporate metacognitive strategy instruction into the biology curriculum, focusing on skills like self-monitoring, planning, and evaluating learning processes to enhance students' retention.

2. Teachers should receive training in metacognitive strategy instruction, learning how to model this strategy and facilitate metacognitive discussions that can encourage students to reflect on their learning, which has a positive effect on both retention and attitude.

3. Government should implement collaborative learning with metacognitive Focus: Group activities that require students to discuss strategy they used for problem-solving in biology can promote the use of metacognitive skills and foster positive attitudes by providing peer support.

4. Students should be taught how to set specific, achievable goals for biology learning activities can improve their motivation and attitude toward the subject, which indirectly supports retention.

References

Abdulrahaman, M. D., & Garba, S. A. (2020). Challenges of implementing Biology curriculum in secondary schools in Niger State, Nigeria. International Journal of Education and Research, 8(2), 59-70.

Ausubel, D. P. (1968). Educational psychology: A cognitive view. Holt, Rinehart and Winston.

Dignath, C., & Veenman, M. V. J. (2021). The role of direct strategy instruction and indirect activation of self-regulated learning Evidence from classroom observation studies. Educational Psychology Review, 33(2), 489-533.

Ezenwosu, S. U., & Okeke, S. O. (2020). Effect of metacognitive teaching strategy on students' achievement and retention in senior secondary school chemistry. Journal of Science Education, 22(2), 120-130.

Ibrahim, A. A., & Bello, Y. (2021). Influence of instructional strategy on students' academic performance in Biology in Niger State, Nigeria. International Journal of Innovative Science and Research Technology, 6(5), 123-130.

Kim, C., & Pekrun, R. (2022). Emotions and motivation in learning and performance. In Handbook of Educational Psychology (pp. 65-80). Routledge.

Mahler, D., Großschedl, J., & Harms, U. (2018). Does motivation matter? The relationship between teachers' self-efficacy and enthusiasm and students' performance. PLOS ONE, 13(11), e0207252.

Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. Review of Educational Research, 76(3), 413-448.

Odom, A. L., & Bell, C. V. (2020). Associations between high school students' conceptions of diffusion and osmosis and their achievement in biology. International Journal of Science and Mathematics Education, 18(6), 1079-1098.

Olakanmi, E. E., & Gumbo, M. T. (2017). Effectiveness of interactive engagement on students' understanding of photoelectric effect. EURASIA Journal of Mathematics, Science and Technology Education, 13(4), 1009-1033.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. International Journal of Science Education, 25(9), 1049-1079.

Neiye, B. C, Schraw, G., & Dennison, R. S. (2019). Assessing metacognitive awareness. Contemporary Educational Psychology, 19(4), 460-475.

Shanahan, M.-C. (2020). Learning in the Biology classroom: The impact of teaching methods on student retention of information. Journal of Biological Education, 54(2), 123-134.

Zepeda, C. D., Richey, J. E., Nokes-Malach, T. J., & Riccio, J. (2019). Direct instruction of metacognition benefits adolescent science learning, transfer, and motivation: An in vivo

study. Journal of Educational Psychology, 111(5), 921-942.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. American Psychologist, 34(10), 906.

Kitsantas, A., & Cleary, T. J. (2021). The influence of metacognition on learning and instruction. Educational Psychology, 12(3), 341-357.

Kostons, D., Van Gog, T., & Paas, F. (2023). Training self-assessment and task selection skills to foster metacognitive regulation and learning. Journal of Educational Psychology, 99(2), 290.

Muhammed, U., & Adamu, A. (2022). Metacognitive regulation and its impact on students' performance. Journal of Nigerian Education, 5(1), 78-95.

Okorie, O., & Hamza, R. (2021). Metacognitive skills and retention in science education. African Journal of Education, 29(2), 118-130.

Okon, M., Usman, B., & Emeka, C. (2023). Enhancing students' learning through metacognitive strategy. Journal of Science Education in Africa, 8(1), 54-67.