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EFFECT OF SELF-ASSESSMENT META-COGNITIVE STRATEGY ON ACADEMIC PERFORMANCE IN BASIC SCIENCE AMONG UPPER BASIC II STUDENTS IN SABON-GARI, KADUNA, NIGERIA

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Abstract

This study investigated the effect of Self-Assessment Metacognitive Strategy (SAMS) on academic performance in Basic Science among Upper Basic II students in Sabon-Gari, Kaduna State, Nigeria. A pre-test, post-test quasi-experimental design was adopted, with a sample of 100 students drawn from two intact classes out of a total population of 8,660 (4,013 males and 4,647 females) across 14 schools in Sabon-Gari Local Government Area. The instrument, Energy Concept Performance Test (ECPT), had a reliability coefficient of r = .76 using the Pearson Product Moment Correlation. The experimental group received instruction through SAMS for six weeks, while the control group was taught using the conventional lecture method. Data were analyzed using descriptive statistics (mean and standard deviation) to answer the research questions, while two null hypotheses were tested at the .05 level of significance using an independent samples t-test. Findings revealed a significant difference between the post-test mean scores of the experimental and control groups, in favor of the experimental group. However, no significant difference was found between the mean performance scores of male and female students taught the energy concept using SAMS. The study concluded that SAMS enhances students' academic performance in Basic Science, is superior to conventional methods, and is gender-friendly. It was recommended that Basic Science teachers adopt self-assessment metacognitive strategies to improve student performance.

Key words: *Basic Science, Self-Assessment Meta-cognitive Strategy, Performance, Gender.*

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Introduction

The Universal Basic Education (UBE) policy in Nigeria was established to provide free and compulsory education at the basic level (Primary 1–6 and JSS 1–3). In May 2004, the UBE Act was signed into law, providing the legal framework for implementation in September 2008 (UBE Act, 2004). The nine-year programme was intended to ensure education for all citizens. Dolapo (2015) highlighted the Federal Government's plans for achieving these goals, including the provision of libraries, health schemes, counseling services, resource centers, and qualified teachers. Mohammed (2016) further emphasized that UBE teaching should be practical, explanatory, and experimental, with English and the local language as the media of instruction.

In response to these policy directives, the role of science and technology in fostering education for all and promoting national development has been increasingly recognized (Ogundele et al., 2020). To strengthen this role, policymakers restructured the curriculum by integrating different science subjects to unify scientific knowledge. Team (2022) explained that biology, physics, and chemistry long regarded as fundamental sciences were merged to keep pace with rapid scientific developments. As a result, post-UBE science subjects such as Biology, Chemistry, Physics, Geography, Computer Science, and Physical and Health Education were integrated into a single subject known as Basic Science and Technology (BST). Chima (2021) noted that BST aims to equip learners with scientific process skills, reflective thinking, curiosity, and scientific attitudes necessary for lifelong success. However, these goals can only be achieved when students demonstrate strong academic performance.

Despite these reforms, evidence consistently shows that students' performance in science remains poor. King'aru (2014) reported that secondary school learners continue to underperform in science despite multiple interventions. Studies have attributed this problem to factors such as inadequate

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funding, lack of instructional materials (Aji & Bukar, 2023), insufficient facilities, out-of-field teaching, inappropriate instructional methods, and poor reading comprehension (Pacala & Cabrales, 2023). Additionally, negative attitudes toward science and persistent use of teacher-centered methods have further contributed to underachievement (King'aru, 2014). Afuwape and Olugbuyi (2019) highlighted that teaching strategies and students' learning styles significantly affect achievement, while Stanton et al. (2021) showed that performance can be improved through metacognitive skills. These findings suggest that a shift from conventional teaching to student-centered approaches is critical.

One promising approach is the use of metacognitive strategies, which enable learners to reflect on their learning processes. Metacognition, often described as "thinking about thinking," involves reflection before, during, and after learning tasks (Özçakmak et al., 2021). It allows students to plan strategies, monitor progress, and make adjustments as needed (Donna & Marcus, 2016; Fiedler et al., 2019). However, without metacognitive awareness, learners often struggle with self-regulation and academic success (Daodu, 2021).

A particularly effective metacognitive technique is self-assessment. Siegesmund (2017) defined self-assessment as the learner's ability to regulate and evaluate learning before, during, and after tasks. Similarly, Brown et al. (2015) described it as a process of reflecting on one's work, identifying strengths and weaknesses, and making necessary improvements. Malamed (2015) added that self-assessment encourages learners to question their assumptions and refine learning strategies. Importantly, self-assessment is considered gender-friendly, making it adaptable for diverse learners.

Nevertheless, gender continues to play a significant role in science education outcomes. Traditionally, gender referred to biological distinctions, but today it also encompasses social and

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cultural roles. Ani et al. (2021) observed that gender sensitivity influences students' performance in Basic Science. While Brajraj et al. (2019) found differences in boys' and girls' attitudes toward science, other studies reported mixed results: Ani et al. (2021) noted that male students outperformed females, whereas Obidike and Onyekwelu (2019) observed the reverse. These inconsistencies highlight the need to further investigate gender differences when introducing new strategies such as self-assessment. Against this background, the present study examines the effect of Self-Assessment Meta-Cognitive Strategy on attitude, performance, and anxiety in energy concepts among Upper Basic II students in Sabon-Gari, Kaduna, Nigeria, with special attention to gender differences.

Statement of the Problem

The Universal Basic Education (UBE) programme in Nigeria was introduced with the hope of giving every child access to free and compulsory basic education. At its core, Basic Science was expected to nurture curiosity, reflective thinking, and problem-solving skills—skills that would not only improve academic performance but also inspire positive attitudes toward science and technology. In practice, however, this vision has not yet been fully realized. Studies continue to show that many students struggle with science subjects, and poor performance remains a persistent challenge despite years of curriculum reform and investment (King'aru, 2014; Zakariya & Bamidele, 2015). Several reasons have been put forward. For example, Aji & Bukar, (2023); Pacala & Cabrales, (2023) stayed that schools still face shortages of instructional facilities, while teaching methods are often teacher-centered and fail to actively engage learners. Many students also carry negative attitudes toward science or experience anxiety in the classroom factors that further weaken their performance. Instead of fostering discovery and reflective learning, lessons

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often reduce students to passive recipients of knowledge. This mismatch between the intentions of the Basic Science and Technology (BST) curriculum and the realities of classroom practice continues to widen the gap in learning outcomes. One way forward may be through innovative, student-centered strategies that give learners more control over their learning. Metacognitive approaches, particularly self-assessment, are promising in this regard. Self-assessment encourages students to reflect on what they know, identify where they struggle, and adjust their learning strategies accordingly. Researchers such as Brown et al. (2015) and Siegesmund (2017) have shown that when learners practice self-assessment, they often feel more motivated, less anxious, and more successful in achieving their goals. Unfortunately, Nigerian classrooms still make little use of such approaches, relying heavily on traditional methods that leave students with limited room to think for themselves. This raises an important question: if self-assessment can help students become more confident, reflective, and better performers in science, what impact might it have when applied deliberately in the teaching of Basic Science concepts? It is this question that the present study seeks to address.

Objectives of the Study

The main objective of this study is to find out the effect of Self-Assessment Meta-Cognitive Strategy on performance of Upper Basic II students. Specifically, the objectives of this study are to:

find out the effect of self-assessment meta-cognitive strategy on the academic performance of Upper Basic II students taught energy concept.

determine the effect of self-assessment meta-cognitive strategy on academic performance among male and female upper basic school students taught energy concept.

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Research Questions

The following research questions were guided the study.

What is the difference between the mean performance scores of Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy and those taught using the conventional method?

What is the difference between the mean performance scores of male and female Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy?

Null Hypotheses

The following null hypotheses were tested at P≤ 0.05 level of significance:

Ho_1: there is no significant difference between the mean performance scores of Upper Basic II students taught energy concepts using self-assessment meta-cognitive strategy and those taught using the conventional method;

Ho_2: there is no significant difference between the mean performance scores of male and female Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy.

Methodology

This study adopted a quasi-experimental design using the pre-test, post-test control group approach. Two groups were involved: the Experimental Group (EG), which was taught the concept of energy using the Self-Assessment Metacognitive Strategy (X_1), and the Control Group (CG), which was taught the same concept using the conventional method (X_0). Both groups were pretested to establish that there was no significant difference in their academic performance prior

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to the treatment. A six-week instructional period was administered, during which the experimental group was exposed to the metacognitive strategy while the control group received conventional instruction. At the end of the treatment, a post-test was administered to both groups using the same instrument as in the pretest to assess their academic performance.

The population of the study comprised all Upper Basic Education II (UBE II) students in Sabon-Gari Local Government Area (LGA). The LGA had 14 public secondary schools with a total population of 8,660 students, of which 4,013 were male and 4,647 were female. UBE II students were selected for this study because they had previously been introduced to Basic Science in UBE I, were more stable in school than UBE I entrants, and were not as distracted as UBE III students, who were often preoccupied with preparation for the Basic Education Certificate Examination (BECE).

The sample size consisted of 100 students: 44 males and 56 females. These were drawn from two intact classes in two different schools—one assigned to the experimental group (71 students) and the other to the control group (29 students). The study employed a simple random sampling technique using balloting. Ten names of co-educational schools (out of 14) were written on pieces of paper, folded, and shuffled. A paper was picked at each draw without replacement until four schools were selected. The four schools were then subjected to the Energy Concept Performance Test (ECPT), which was administered, marked, and analyzed using Analysis of Variance (ANOVA) at $p < 0.05$ to determine equivalence in academic performance. Since ANOVA showed significant differences, a Scheffé post-hoc test was conducted to identify two schools with no significant difference, which were then selected for the study.

The Energy Concept Performance Test (ECPT) was administered as a pretest to both the experimental and control groups before the treatment. The experimental group was then taught the

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energy concept using the Self-Assessment Metacognitive Strategy, while the control group was taught using the conventional method. After six weeks of instruction, the ECPT was re-administered as a post-test to both groups. The responses were scored and prepared for analysis.

The research questions were answered using descriptive statistics (mean and standard deviation). The null hypotheses were tested using inferential statistics, specifically the independent samples t-test, at a 0.05 level of significance.

Results and Discussion

The data collected from the field using the Energy Concept Performance Test (ECPT) was analyzed. Results obtained were used to answer the research questions and test the null hypotheses as follows:

Answer to Research Questions and Testing The Null Hypotheses

Research Question One: What is the difference between the mean performance scores of Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy and those taught using the conventional method?

To answer research question one, post-test scores of experimental and control groups generated from Energy Concepts Performance Test (ECPT) were subjected to descriptive analysis. The mean and standard deviation statistics is presented in 1.

Table 1: Mean and Standard Deviation of Posttest Scores of Students in the Experimental and Control Groups

Groups	N	Mean	Std. Deviation	Mean Difference
Experimental	71	45.86	2.30	

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				18.7
Control	29	27.16	3.84	

Significant at P≤0.05

The result in Table 1 showed that the posttest mean academic performance scores of the experimental and control groups were 45.86 and 27.16 respectively. The computed mean difference was found to be 18.7.

To determine whether the mean difference is significant or not, hypothesis one was tested at $\alpha \leq 0.05$. The summary of the analysis is presented in Table 2.

Null Hypothesis One: There is no significant difference between the mean academic performance scores of Upper Basic II students taught Energy concepts using Meta-cognitive Strategy and their counterparts taught using Conventional Method.

To test null hypothesis one, the post-test scores obtained from ECPT of the experimental and control groups were subjected to an independent samples t-test statistics at $\alpha \leq 0.05$. Summary of the analysis is presented in Table 2.

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Table 2: Independent Samples t-test Analysis of Mean Performance Scores between Experimental and Control Groups

Group	N	Mean	Std. Dev.	Df	t-cal	p
Experimental	71	45.86	2.30			
				98	46.25	.000
Control	29	27.16	3.84			

Significant at P$\leq$0.05

Table 2 revealed that the p=.000, is less than 0.05 level of significance at 98 degree of freedom. Therefore, the null hypothesis which stated that there is no significant difference between academic performance mean scores of students taught Energy concepts using Meta-cognitive Strategy and those taught using conventional method is hereby rejected. This implies that there exist significant difference between the performance mean scores of students taught with energy concept using meta-cognitive strategy and those taught with conventional method in favour of the former.

Research Question Four: What is the difference between the mean performance scores of male and female Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy?

To answer research question four, posttest scores of male and female students in the experimental group generated from ECPT were subjected to descriptive analysis. The mean and standard deviation are presented in Table 3

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Table 3: Mean and Standard Deviation of Posttest performance Mean Scores of Male and Female Students in the Experimental Group.

Groups	N	Mean	Std. Deviation	Mean Difference
Male	34	38.86	1.42	
				1.38
Female	37	37.48	1.43	

The result in Table 3 showed that the posttest mean academic performance scores of the male and female students in the experimental group were 38.86 and 37.48 respectively. The computed mean difference was found to be 1.38. To find out whether the difference is significant, the hypothesis four was tested at $\alpha \leq 0.05$ as presented in Table 4

Null Hypothesis Four: there is no significant difference between the mean performance scores of male and female Upper Basic II students taught energy concept using self-assessment meta-cognitive strategy.

To test null hypothesis four, the posttest scores obtained from male and female (ECPT) was analyzed using Independent Samples t-test analysis and the result is presented in Table 4.

Table 4: Independent Samples t-test Analysis of Mean Performance Scores between Male and Female Students in the Experimental Group.

Group	N	Mean	Std. Dev.	Df	t	p	Remark	Decision
Male	34	38.86	1.42					
				71	-.041	0.42	Not Significant	Ho_4 Retained

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Female	37	37.48	1.42

Significant at $p \leq 0.05$

Table 4 showed that, the computed p-value obtained from the analysis is 0.42 which is greater than 0.05 level of significance. The null hypothesis is therefore retained. This means that significant difference does not exist between the mean performance scores of male and female students taught Energy concepts with self-assessment meta-cognitive strategy.

Discussion

The discussions of the findings of the present study are here been presented in relation to both research questions and hypotheses.

The result from statistical analysis of hypothesis one in table 4.2 revealed that the experimental group that exposed to self-assessment metacognitive strategy perform better than the control group that was exposed to conventional method. This finding agreed with the finding of Magaji and Umar (2016) and Abdul-Rehman (2017). The finding is in disagreement with that of Reinhard et al (2021) and Koenig et al. (2024) while metacognitive beliefs about competence can be easily swayed by external input, the underlying ability to accurately evaluate one's own performance may require more robust or different kinds of interventions.

The results of Hypothesis Four in table 4.8 revealed that there was no significant difference in the mean performance scores of male and female subjects in the experimental group. This indicates that metacognitive strategy is gender friendly and is favourable to male and female students. This finding is in agreement with the finding of Adah and Anari (2022) and the finding of Hüseyin *et al.*, (2021). The findings are in disagreement with the study of Dew et al., (2020) who reported that, male students tended to achieve slightly higher scores on midterm exams and final course

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grades, with the most notable differences observed in algebra-based mechanics courses. indicating that even within learning environments that likely incorporated elements of metacognitive or student-centered instructional approaches, gender-related disparities in performance persisted.

Conclusion

From the results and the findings of this study, it was concluded that self-assessment meta-cognitive strategy effectively improves academic performance in Basic Science demonstrating its superiority over conventional methods and its gender friendly .

Recommendation

Based on the findings of this study, the following recommendations are made:

Basic science teachers should adopt self-assessment meta-cognitive strategies in science teaching to enhance student performance.

Curriculum planners incorporate meta-cognitive strategies into the science curriculum for upper basic education.

Policy Makers should encourage the integration of innovative teaching methods through policies and incentives.

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