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RESEARCH ARTICLE

METACOGNITIVE APPROACH TO ENHANCING MATHEMATICAL PERFORMANCE AMONG PRIMARY SCHOOL STUDENTS IN RURAL AND URBAN AREAS OF KOGI STATE

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Abstract

In this study, a quasi-experimental design was employed to ascertain the effect of the metacognitive instruction approach on primary school students' mathematical performance in Kogi State. A total of seventy-two students with an age range of 7 – 11 years and a mean age of (M=9.12), (SD= 1.22) participated in the study. The participants were grouped into two and were subjected to a pre-test and post-test study. Mean, and standard deviation scores were used, and an independent t-test analysis conducted on the data established a statistically significant difference between the groups, MD = 11.54 (95% CI, 7.91 to 15.14), $t(70) = 6.313$, $p = .001$. Thus, the result supported the study's hypothesis. It was concluded that metacognition is effective in enhancing student's mathematics performance. The study recommends that teachers be regularly trained on the use of the metacognitive approach in the classroom.

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Introduction:-

The importance of mathematics in achieving success and national development is very noticeable in developing and developed countries (Etuk & Bello, 2016; Josiah & Olunmi Adejoke, 2014). Mathematics plays a crucial role in the development of human capital in Science, Technology, Engineering, and other critical sectors of the economy (Musa & Dauda, 2014), and anchors as one of the implications for the attainment of the shared vision of the Federal Government of Nigeria (Charles-Ogan, 2015). Accordingly, Usman (2002) pointed to mathematics and its applications as an inevitable part of education. Mathematics education has been implicated as one of the criteria for measuring a country's socio-economic development.

In Nigeria, mathematics is one of the core subjects for students at the senior secondary school level (NPE, 2004) and a compulsory subject for all students (Ugodulunwa & Okolo, 2015). Mathematics is necessary for anybody wishing to advance in any academic career, whether science or art. Mathematics is a core subject that students must study at any education level (Adebule & Ayoola, 2015). However, Mathematics education is currently not in a good phase regarding pedagogy (Adedeji, 2018). Over the years, the subject of mathematics has been perceived mostly as a complex subject (Dele-Ajayi et al., 2019). The trend has contributed to the growing loss of interest and poor performance in math-related tasks among students in different education levels in Nigeria.

Despite the importance of mathematics, evidence has shown that students' performance relating to mathematics in Nigeria remains poor (Aburime, 2007; Agnes & Mathew, 2019; Dada & Akpan, 2019; Joseph et al., 2020; Muhammad et al., 2015; Ogochukwu, 2010; Olanrewaju & Suleiman, 2019; Owan, 2018; Salami & Okeke, 2017).

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For instance, factors such as curriculum and methods (Muhammad et al., 2015), class size (Afolabi et al., 2020; Idowu, 2016), poor mathematics foundation and uncondusive environment (Adolphus, 2011), student' handwriting (Oche, 2014), and other student's factors (Adesoji & Yara, 2008) have been associated with the observed poor performance in mathematics in Nigeria. Consequently, the continuous reliance on the conventional and theoretical approach in teaching and learning mathematics within Nigeria's primary and secondary education levels seems unproductive. The trend is pervasive within the rural communities and is implicated in the lower performance in mathematically related tasks among students. Perhaps, there is the need to explore further instructional alternatives to improve mathematical learning in the Nigerian context.

Metacognition is increasingly becoming an essential factor in the teaching and learning of mathematics. Metacognition refers to the ability to represent, monitor, and control ongoing cognitive processes (Heyes et al., 2020). It is the set of processes people adopt in monitoring ongoing cognition to checkmate their behavior (Rhodes, 2019). (Fleming & Lau, 2014) stated that metacognition is the ability to recognize one's successful cognitive processing in perceptual or memory tasks. Indeed, metacognition enables an individual to engage in explicit reasoning (Shea, 2020). Previous studies have established a link between metacognition and increased learning performance (Al-jarrah et al., 2019; Kane et al., 2014; Millis, 2016; Persky & Dinsmore, 2019; Schleifer & Dull, 2009). Strong metacognition skills are associated with learning outcomes and student performance (Stanton et al., 2015). The benefits of metacognition and active learning on student performance are well understood (Mutambuki et al., 2020). However, evidence that metacognition has an impact on learning mathematics is still growing.

Following the relevance attached to mathematics and the observed low achievement in mathematics, various instructional strategies have been explored by scholars. For example, strategies such as motivational and enhancement of academic self-efficacy (Fehintola, 2020), problem-based learning (Fatade et al., 2013), flipped classes (Makinde, 2020), peer tutoring strategy (Muhammad Sani Abdurrahman et al., 2015), improvisation (Okori & Jerry, 2017), multimedia presentations (Nwaocha, 2010), and student-problem skills (Nenty, 2001) has been deployed in enhancing mathematical learning, and the results are all positive. For instance, (Ofem et al., 2017) used the diagnostic and feedback assessment approach. The outcome proved effective in enhancing mathematics achievement among secondary school students in Nigeria. The present study is aimed to explore metacognition as an instructional approach to enhance teaching and learning of mathematics among rural and urban students in Kogi state. The study's primary purpose is to examine whether the metacognitive approach will enhance student's performance in mathematic. Thus, the study hypothesized that the metacognitive approach would enhance student's performance in mathematics.

Method:-

The research adopted a quasi-experimental design with pre-test and post-tests, and two groups (experimental and control) were applied. Seventy-two school-going children were randomly selected from primary schools in urban and rural areas of Kogi State as the research participants. The students comprising males and females within the age range of 7 – 11 years and mean age of (M=9.12) and (SD= 1.22) were assigned to groups. The student's mathematics knowledge was established in the pre-test study. The student in the treatment group was exposed to a mathematical task containing metacognitive questions. The control group students were given the same mathematical task without the metacognitive questions in the post-test study. After that, the performance was assessed using a mathematics performance test.

Measure:-

Mathematics performance was assessed using a self-developed instrument adapted from relevant literature. The Linkert type scale contains two parts: A, and B, with part assessing basic conceptual knowledge comprising three questions demanding brief response while part B consist of problem-solving and processes of five questions, two of which are routine problems while the other three questions are non-routine problems. The instrument was scored over one hundred (100). The instrument recorded a 0.79 internal consistency reliability coefficient.

Result:-

Table 1:- Table shows mean and standard deviation scores of the students' mathematics performance for groups A and B.

Group	N	Mean	SD
Group A	37	21.11	3.14

Group B	35	21.29	2.91
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The table above shows that in the pre-test study, the mean scores of 21.11 and 21.29 were obtained for both groups respectively, on the other hand, standard deviation scores of 3.14 and 2.91 were recorded. This means no significant difference was obtained in the experimental and control groups' mean scores in the pre-test study. This indicates that the group's mathematics performance level was almost equal.

Table 2:- Table showing the mean and standard deviation scores of the two groups (A and B) following the Post-test study.

Group	N	Mean	SD
Group A	37	34.71	9.45
Group B	35	23.18	5.39

The above table shows that the mean scores of 34.71 and 23.18 were recorded for groups A and B after the post-test study. The data indicates a high mean score for the study group (34.71) compared to the control group (23.18). The standard deviation scores also revealed an increased score of 9.45 for the study group and a lower score of 5.39 for the control group. Therefore, we assume that the mean scores show that group A's performance was enhanced due to the exposure to metacognitive tasks.

Table 3:- t-test comparison of the mathematical performance of the experimental and control groups.

Source of variation	N	Mean	SD	df	t	Sig
Group A	37	34.71	9.45			
Group B	35	23.18	5.39	70	6.313	.000

An independent-samples t-test was conducted to determine if there were differences between the experimental and the control groups on mathematics performances in the post-test study. The mathematics performance of the experimental group was found to increase (34.71 ± 9.45) compared to the control group (23.18 ± 5.39), a statistically significant difference of 11.54 (95% CI, 7.91 to 15.14), $t(70) = 6.313$, $p = .001$.

Discussion:-

The current study was conducted to determine whether metacognition as a teaching strategy would enhance primary school students' mathematical performance. Perhaps the independent t-test conducted on the data following the pre-test and post-test studies proved that metacognition enhanced the participants' mathematical performance at $MD = 11.54$ (95% CI, 7.91 to 15.14), $t(70) = 6.313$, $p = .001$. Thus, the result supported the assumption of the study that metacognition will enhance the mathematical performance of primary school students. The study's result is consistent with the previous studies (Nett et al., 2012; Veenman et al., 2006). For instance, (Desoete et al., 2019) reported that metacognitive skills were significant predictors of mathematical accuracy. This indicates that applying the metacognition approach in the teaching and learning of mathematics in Nigeria will significantly promote students' performance and achievement in mathematics-related tasks. The study provides insight into the effectiveness of metacognition in the classroom and suggests the adoption in all spheres of primary education. Perhaps, research suggests that children who lag in metacognitive development may be at risk of study play in mathematics (Desoete & de Craene, 2019). A similar study conducted using secondary school students found that math metacognitive strategy improved pupils' achievement in fractional mathematics (Onu et al., 2012). Although research in metacognition is increasing in Nigeria, it is reported that students are not fully aware of the importance of the strategy in learning (Okoza et al., 2013). Thus, there is still a need for a robust step-up in metacognition literature. In line with similar studies utilizing metacognition in other learning domains (Owo & Ikwut, 2015; Oyelekan et al., 2019), the present study is proof of the relevance of metacognition in enhancing learning in Nigeria. However, according to (Stanton et al., 2015), the utilization of metacognitive strategy in learning is useful for some students. However, most students may need help with metacognitive knowledge to execute the learning strategies they select. It is suggested that teachers recognize differences in students' responses to metacognitive instruction packages to establish differences and solutions.

Conclusion:-

In response to the study hypothesis, the result revealed, in line with Nett et al. (2012) and Desoete et al. (2019), that metacognition predicted the variance in student's mathematical performance. Thus, it was concluded that metacognition is an indispensable tool in mathematics in primary school. The study contributes to the mathematics literature by supporting the use of metacognition in enhancing student's performance in mathematics in Nigeria. Nevertheless, the present study encountered certain limitation that needs to be addressed. First, the sample size was

small and may not be reliable for generalization. Also, the design of the study did not allow for cause-effect determination. Future researchers are advised to include more representative samples and adopt pure experimentation to ascertain cause-effect relationships. However, we recommend that teachers be regularly trained on using the metacognitive approach in the classroom. The use of metacognition should be embedded in the school curriculum.

Ethical consideration

The researchers made sure that the study procedures involving human participants were done following the institution's ethical standard.

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