USING METACOGNITIVE METHOD TO IMPROVE PERFORMANCE IN MATHEMATICAL AMONG PRIMARY SCHOOL STUDENTS IN EBONYI STATE, NIGERIA

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Abstract

Concern is rising over the prevalence of a negative view of mathematics in Nigeria's classrooms. Several studies have highlighted effective strategies for overcoming the problem of negative math attitudes. However, there is a lack of information about how metacognitive instruction can help students develop positive attitudes toward mathematics. This study used a quasi-experimental design to investigate how the metacognitive instruction strategy influenced the mathematical dispositions of secondary school students in Ebonyi State. Ninety-one (n = 91) students comprising males and females between the ages of 10 and 14 years with a mean age of (M=9.14) and (SD= 1.24) were randomly selected from different public secondary schools in Ebonyi State as the study participants. The participants were grouped into two and were subjected to a pre-test and post-test study. The independent t-test conducted on the data following the pre-test and post-test studies proved that Metacognition enhanced the participants' mathematical attitudes at MD = 13.65 (95% CI, 8.91 to 16.17), t (89) = 6.328, p = .001. Thus, the result supported the study's hypothesis. It was concluded that Metacognition is effective in enhancing students' mathematics attitudes. The study recommends regularly training teachers on using the metacognitive approach in the classroom.

***Keywords**:* Metacognition, math, attitudes, students

Introduction

Mathematical studies entail studying how numbers, shapes, and arrangements make sense. Every aspect of our lives, from the simplest tasks to the most cutting-edge technological developments, can be traced back to mathematics. The importance of mathematics to personal success and societal progress is evident in developing and developed countries (Etuk & Bello, 2016; Josiah & Olubunmi Adejoke, 2014). Studying and applying mathematics is crucial to developing human capital in the economically vital fields of science, technology, and engineering (Musa & Dauda, 2014). It reflects a common goal of the Nigerian government's education policy (Charles-Ogan, 2015). Indeed, Usman (2002) argues that it is essential for students to learn both theoretical mathematics and its real-world applications. Education in mathematics has been suggested as one of the factors that should be considered when evaluating the level of socioeconomic progress in a nation.

The educational ecosystem in Nigeria recognizes mathematics as one of the fundamental courses pupils must study (NPE, 2004) and a compulsory subject for all students (Ugodulunwa & Okolo, 2015). Anyone who wants to succeed in an academic career, whether in science or art, must have a solid understanding of mathematics. Any educational level requires pupils to learn mathematics as an essential subject. (Adebule & Ayoola, 2015). However, research has pointed to pedagogical

challenges in mathematics education (Adedeji, 2018). Thus, resulting in the broad conception of mathematics as a complex subject (Dele-Ajayi et al., 2019). This trend has resulted in an increasing loss of interest and poor performance in math-related tasks among Nigerian students of various educational levels.

Despite the significance of mathematics, research has demonstrated that Nigerian pupils continue to do poorly in this subject area (Aburime, 2007; Agnes & Mathew, 2019; Dada & Akpan, 2019; Joseph Owan et al., 2020; Abdurrahman et al., 2015; Ogochukwu, 2010; Olanrewaju & Suleiman, 2019; Owan, 2018; Salami & Okeke, 2017). For instance, factors such as curriculum and methods (Abdurrahman et al., 2015), class size (Afolabi et al., 2020; Idowu, 2016), poor mathematics foundation and unconducive environment (Adolphus, 2011), student' handwriting (Oche, 2014), and other student's factors (Adesoji & Yara, 2008) have been linked to the country's notably low math scores. Therefore, it appears pointless to keep using the same old traditional and theoretical method for teaching and studying mathematics at Nigeria's primary and secondary school levels. This widespread pattern is likely to be blamed for students' poor results in math-related tasks and adverse mathematics attitudes.

The term attitudes describe a socio-psychological construct reflecting a person's cognitive, affective, and behavioral dispositions critical to learning. Attitudes encompass likenesses or dislikes of any aspect of a person's socio-world. Thus, a negative attitude limits performance, reduces motivation, and inhibits learning. Research has linked low achievement and engagement in mathematics with attitudes (Yáñez-Marquina & Villardón-Gallego, 2016). Some pupils in high school have the misconception that mathematics is uninteresting and irrelevant to their lives because of its perceived difficulty in understanding it and its perceived lack of concrete application. Students in elementary and secondary school often perform well at first but develop a dislike for and anxiety about mathematics with time. This can make them feel uninspired and undermine their confidence as they attempt to solve problems. For some, the prospect of sticking with and mastering more complex mathematical concepts is terrifying. Some pupils, it seems, do not see the value in continuing their math education beyond the basics. When students have a negative outlook on mathematics, they may (or may not) be able to apply what they learn in the classroom to real-world situations. Nonetheless, adverse attitudes about mathematics are widespread and have been reported in the post-primary education of Ebonyi State (Adolphus, 2011; Arokoyu, 2018; Obomanu & Adaramola, 2011). Thus, the trend reflects a significant challenge in the development of mathematics education in the state. The present study examines Metacognition as a strategy to enhance negative mathematics attitudes in the post-primary education of Ebonyi State, Nigeria.

Metacognition is increasingly becoming an essential factor in the teaching and learning of mathematics. Metacognition is 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). Accordingly, Fleming and Lau (2014) stated that Metacognition reflects using one's successful cognitive processing in perceptual or

memory tasks. Indeed, Metacognition enables an individual to use 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 impacts 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 teaching (Fatade et al., 2013), flipped classes (Makinde, 2020), peer tutoring strategy (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 effectively enhanced mathematics achievement among secondary school students in Nigeria. The present study is aimed to explore Metacognition as an instructional approach to enhance students' attitudes towards mathematics among students in the Ebonyi State post-primary education system. The study's primary purpose is to examine whether there would be a significant difference between the students' thoughts with Metacognition and those not exposed to Metacognition attitudes towards mathematics. Thus, the study hypothesized as follows:

H^1: there is a difference between students exposed to Metacognition and students not shown metacognition approach on attitude towards mathematics.

Method

A quasi-experimental design with pre-test and post-tests and two groups (experimental and conditions) was adopted in this present study. Secondary school students in Ebonyi State made up the population of the study. Ninety-one (n = 91) students comprising males and females between the ages of 10 and 14 years with a mean age of (M=9.14) and (SD= 1.24) were randomly selected from different public secondary schools in Ebonyi State as the study participants. The students selected primarily from the junior classes were assigned to groups, with group A as the experimental condition. On the other hand, group B represents the control condition. Before the main study's commencement, students' attitude towards mathematics was established (pre-test) using an attitude towards mathematics questionnaire. 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 structured questionnaire.

Ethical considerations

In order to abide by the research ethics in the study process, the researcher, with the help of the heads of the schools and teachers, briefed the participants on the study's purpose. They were told that the study was not a must and that they could withdraw anytime they wanted.

Result

Before the commencement of the experiment, the respondent's attitudes toward mathematics were measured.

Table 1: shows the mean and standard deviation scores of the student's attitudes toward mathematics for both conditions.

Group	N	Mean	SD
Group A	43	22.19	3.18
Group B	48	22.33	2.96

Table 1: shows the mean scores of the two conditions in the pre-test study. Thus, it indicates that there is no significant mean difference between the conditions on attitude towards mathematics (*M*= 22.19, *SD=3.12)* and (*M*= 22.33, *SD*= 2.98). Thus, it signifies that attitude towards the subject for both conditions is on the same level.

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

Group	N	Mean	SD
Group A	43	46.83	9.64
Group B	48	33.18	5.26

More so, a post-study analysis was conducted to ascertain the difference in attitude towards mathematics. The mean scores for both conditions were (*M* = 46.83, *SD* = 9.64, and *M* = 33.18, *SD* = 5.26), as shown in Table 2 below. The data established a high mean score for the experimental conditions (46.831) compared to the control condition (33.18). The standard deviation scores also revealed an increased score of 9.64 for the study group and a lower score of 5.26 for the control group. Thus, it indicates that the mean scores increased significantly following the students' exposure to the metacognitive process.

Table 3: showing the t-test comparison of the differences in attitude towards mathematics.

Source of variation	N	Mean	SD	df	*t*	Sig
Group A	43	46.83	9.64			
Group B	48	33.18	5.26	89	6.328	001

An independent-samples t-test was conducted to determine if there were differences between the experimental and the control groups' attitudes toward mathematics in the post-test study. The result

of the analysis established an increased positive attitude towards mathematics for the experimental condition (46.83 ± 9.64) compared to the control condition (33.18 ± 5.26). A statistically significant difference was established at 13.65 (95% CI, 8.91 to 16.17), t (89) = 6.328, p = .001.

Discussion

The current study determined whether Metacognition as a teaching strategy would enhance students' attitudes toward mathematics. Indeed, the independent t-test conducted on the data following the pre-test and post-test studies proved that Metacognition enhanced the participants' mathematical attitudes at *MD* = 13.65 (95% CI, 8.91 to 16.17), t (89) = 6.328, p = .001. Thus, the result supported the assumption of the study that there is a difference between students exposed to Metacognition and those not taught metacognitive measures on attitude toward mathematics. 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 significantly predict mathematical accuracy. This indicates that applying the metacognition approach in teaching and learning mathematics in the post-primary education of Ebonyi State, Nigeria, will significantly promote students' attitudes and improve mathematics-related tasks. The study provides insight into the effectiveness of Metacognition in the classroom and suggests its adoption in all spheres of education. Indeed, research suggests that students lagging in metacognitive development may be at risk of underdevelopment 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 teaching (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), using a metacognitive strategy in learning is helpful for some students. However, most students may need help with metacognitive knowledge to execute their learning strategies. 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 students' mathematical attitudes. Thus, it was concluded that Metacognition is an indispensable tool in combating negative mathematical attitudes in the school system. In math instruction, Metacognition involves active learning that helps students become aware of, reflect upon, and consciously direct their thinking and problem-solving efforts. In order words, the study suggests that a student who tries to solve a problem without metacognitive awareness and regulation might rush towards finding a solution without comprehensively analyzing and understanding the problem from the outset. Therefore, Metacognition matters in building a mathematical attitude in the students. The study contributes to the mathematics literature by supporting the use of Metacognition in enhancing students'

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 should include more representative samples and adopt pure experimentation to ascertain cause-effect relationships. However, we recommend regularly training teachers on using the metacognitive approach in the classroom. The use of Metacognition should be embedded in the school curriculum.

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