ADVERSE MATH ATTITUDES IN THE POST-PRIMARY EDUCATION OF RIVER STATE, NIGERIA: CAN METACOGNITION DO THE MAGIC?

Okoro Joyce Adaobi*

*Department of MathematicsFederal College of Education, Technical, Omoku, River State, Nigeria

Abstract
There is growing concern about the increasing adverse attitude towards mathematics in Nigeria’s educational system. Numerous research has underscored appropriate steps to address the challenge of mathematics attitudes. However, little is known about the role of metacognitive teaching in promoting healthy math attitudes. The present study employed a quasi-experimental design to examine the effect of the metacognitive instruction approach on students’ mathematical attitudes in River 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 River 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 that teachers be regularly trained in using the metacognitive approach in the classroom.

Keywords: Metacognition, math, attitudes, students
BACKGROUND
Mathematics describes the science of shape, quantity, and arrangement logic. Math is a ubiquitous part of our everyday lives and reflects the building block for everything in our daily lives, including the advances in technological innovations. In developing and developed nations, the value of mathematics in achieving success and contributing to national development is evident. (Etuk & Bello, 2016; Josiah & Oluibumnmi Adedjoko, 2014). The growth of human capital in the fields of science, technology, engineering, and other essential economic areas depends critically on the study and use of mathematics. (Musa & Dauda, 2014). It serves as one of the pathways for realizing the shared goal of the Nigerian government. (Charles-Ogan, 2015). According to Usman (2002), education must include mathematical concepts and their practical applications. Education in mathematics has been suggested as one of the factors that should be considered when evaluating a nation's socioeconomic progress level.

The educational ecosystem in Nigeria recognizes mathematics as one of the fundamental courses pupils are required to 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 a basic subject. (Adebiyi & Ayoola, 2015). However, research has pointed to pedagogical challenges in mathematics education (Adeleji, 2018), thus, resulting in the expansive 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; Ogbochukwu, 2010; Olanrewaju & Suleiman, 2019; Owan, 2018; Salami & Okeke, 2017). For instance, factors such as curriculum and methods (Muhammad Sani 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 River state (Adolphus, 2011; Arukoyu, 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 for enhancing negative mathematics attitudes in the post-primary education of River 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). (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 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; Milllis, 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 (Muhammad Sani Abdurrahman et al., 2015), improvisation (Okori & Jerry, 2017), multimedia presentations (Nwaucha, 2010), and student-problem skills (Nenty, 2001) has been deployed in enhancing mathematical learning, and the results are all positive. For instance, (Ogem 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 toward
mathematics among students in the River state post-primary education system. The study's primary purpose is to examine whether there would be a significant difference between the student's thoughts with metacognition and those not exposed to Metacognition on attitude towards mathematics. Thus, the study hypothesized as follows: 

\( H^1 \): there is a difference between students exposed to Metacognition and students not shown the 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 River 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 River 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**

The researcher tried to abide by the research ethics in the study process. With the heads of the schools and teachers’ aid, the participants were made to understand 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.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>43</td>
<td>22.19</td>
<td>3.18</td>
</tr>
<tr>
<td>Group B</td>
<td>48</td>
<td>22.33</td>
<td>2.96</td>
</tr>
</tbody>
</table>

Table 1: shows the mean scores of the two conditions in the pre-test study. Thus, it indicates 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: showing the mean and standard deviation scores of the two conditions (A and B) following the Post-test study

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>43</td>
<td>46.83</td>
<td>9.64</td>
</tr>
<tr>
<td>Group B</td>
<td>48</td>
<td>33.18</td>
<td>5.26</td>
</tr>
</tbody>
</table>

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 \((46.83)\) 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.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>df</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>43</td>
<td>46.83</td>
<td>9.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group B</td>
<td>48</td>
<td>33.18</td>
<td>5.26</td>
<td>89</td>
<td>6.328</td>
<td>.001</td>
</tr>
</tbody>
</table>

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 \((46.83 \pm 9.64)\) when compared to the control condition \((33.18 \pm 5.26)\); a statistically significant difference was established at 13.65 \((95\% \text{ CI, } 8.91 \text{ to } 16.17)\), \(t (89) = 6.328, p = .001\).

**Discussion**

The current study determined whether Metacognition as a teaching strategy would enhance primary school 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 \(MD = 13.65 \ (95\% \text{ CI, } 8.91 \text{ to } 16.17)\), \(t (89) = 6.328, p = .001\). Thus, the result supported the assumption of the study that there is a difference between
students exposed to Metacognition and those who were not taught the metacognitive measure of 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 were significant predictors of mathematical accuracy. This indicates that applying the metacognition approach in teaching and learning mathematics in the post-primary education of River 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 specific 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 regular training teachers on using the metacognitive approach. The use of Metacognition should be embedded in the school curriculum.

References


