



## Self-Efficacy as Predictor of Academic Achievement of Secondary School Students with Developmental Dyscalculia in Nsukka Educational Zone, Enugu State

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### Abstract

This study assessed the impact of self-efficacy on the academic achievement of mathematics students with developmental dyscalculia (DD) in Mathematics within Nsukka Education Zone, Enugu State. Two research questions and two null hypotheses guided the study while a correlational research design was adopted. The study included 160 students from seven co-educational schools in the specified zone who displayed symptoms of developmental dyscalculia (DD), identified through the paper-based Developmental Dyscalculia Identification Scale (DDIS). Other data collection instruments were self-administered Mathematics Self-Efficacy Scale (MSES) and Mathematics Achievement Test (MAT). Analysing the data using Fisher's z-score, linear regression, and one-way analysis of variance revealed that self-efficacy significantly predicted ( $p$ -value = 0.011) academic achievement among senior secondary school students with developmental dyscalculia in Mathematics. However, there was no gender-related significant variance ( $p$ -value = 0.2801) in this relationship. The study recommends personalized support and evaluation by school administrators and stakeholders for students with DD.

**Keywords:** Academic achievement, Developmental dyscalculia, Mathematics, Self-efficacy, Secondary school

### Introduction

Despite the importance of mathematics in society, the academic achievement of students in mathematics in recent years have left much to be desired. The West African Secondary School Certificate Examination (WASSCE), which is externally moderated and enjoys a high level of public trust, has shown an elevated rate of failure in core subjects such as Mathematics. With the exception of 2014 WASSCE, the proportion of candidates in Nigeria who obtained a pass (D7-E8) has generally been higher than those who had a credit pass (A1-C6), according to Owan's (2020). The proportion of candidates that failed (F9) has likewise remained continuously high over the past 10 years, rising from 26.11% in 2012 to 48.56% in 2017. More specifically, Inweregbugh, Osakwe, Ugwuanyi, and Agugoesi (2020) found that students in senior secondary schools in Nsukka Educational Zone had also been performing poorly academically in mathematics.

This low academic achievement in mathematics has been attributed to several factors by many scholars. One of such notable factors is a learning disorder known as developmental dyscalculia (DD). This disorder hinders a student's ability to learn number-related ideas and carryout mathematical computations. According to Szűcs and Goswami (2013), DD is a chronic mathematical difficulty caused

by cognitive function or representation impairments during development. It usually becomes apparent when a student is learning mathematics and getting adequate instruction in the field of study. The prevalence of DD in Nigeria has been estimated to range from 18% to 25%. Students with DD face greater difficulty acquiring core mathematical concepts, making it difficult for them to achieve good academic achievements in Mathematics. Self-efficacy can influence students' academic achievements in subjects such as Mathematics, which entail tasks that may be challenging for DD pupils and demand persistence. Thus, increasing students' self-efficacy is critical to improving their ability to recognize and fight negative self-perceptions.

Self-efficacy is a person's belief in his or her capacity to accomplish tasks. Self-efficacy, the focal point of Albert Bandura's social cognitive theory, is an assessment of one's ability to complete a specific and foreseeable task (Bandura, 1997). It is an individual's ability to plan and influence tactics to achieve goals (Mariera, Murugam, & Muthee, 2021). Students with low self-efficacy for learning a specific task, such as mathematics, may avoid or give up quickly, whereas those who believe they are capable work harder and continue longer (Koponen et al., 2021). As a result, students' self-efficacy plays an

essential role to their academic achievement. Self-efficacy in Mathematics among students with DD is an exciting area to explore because it would reveal the motivational needs that should be put in place to encourage students to believe in their capabilities to counter difficulties while performing tasks related to Mathematics.

Students with mathematics-related learning difficulties, such as DD, are more likely to be motivated if they have high self-efficacy levels. According to Hen and Goroshit (2014), this is because self-efficacy causes a shift in mindset, with affected individuals taking a more active part in improving themselves. Increased self-efficacy has a favourable impact on academic outcomes such as classroom engagement, grades, and the likelihood of remaining determined to pursue academic success. This indicates that students with DD will recognize that academic achievement is not solely determined by the student's abilities. Positive self-efficacy moves the focus away from any deficits that such students may have and towards their strengths. Comparing students with and without learning difficulties, Bergen (2013) found that self-efficacy had a substantial impact on overall academic achievement. Contrary to the findings above, Bandura (2013) claimed that because other factors must be considered, it is more appropriate to conclude that the student's achievement on previous tasks can predict the outcome of a future test based on the student's self-efficacy. This viewpoint demonstrates that a student's self-efficacy level may only occasionally impact academic success. Furthermore, Karofi and Kasimu (2020) found no association between students' self-efficacy and academic achievement.

As can be seen from the preceding articles, there are various opinions on the impact of self-efficacy on academic achievement. Nonetheless, more study on the impact of self-efficacy on academic achievement of especially DD students is required. Additionally, Siddiq and Scherer (2019) emphasized the importance of gender studies since they can disclose existing disparities, which is crucial to bridging gaps and combating inequities. Therefore, the purpose of this study was to determine whether self-efficacy can predict the academic achievement of DD students in Mathematics with gender as the moderating variable.

### Research Questions

The following research questions were addressed in this study:

1. What amount of variation in the academic achievement of students with developmental

dyscalculia in Mathematics is attributed to self-efficacy?

2. What amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics is predicted by self-efficacy, as moderated by gender?

### Hypotheses

The following null hypotheses are formulated for the study and will be tested at  $p < 0.05$  level of significance.

- Ho<sub>1</sub>: The amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics that is attributed to self-efficacy is not significant.
- Ho<sub>2</sub>: The amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics that is predicted by self-efficacy, as moderated by gender is not significant.

### Research Method

This study adopted a correlational research design, which aims to uncover connections between two or more variables and determine how changes in the independent (predictor) variable can predict variations in the dependent (criterion) variable through regression analysis (Nworgu, 2015). Since the study intends to determine whether self-efficacy can predict academic achievement among students with DD, a correlational design allows for the identification of predictive patterns and the estimation of how much variance in academic achievement can be attributed to variations in self-efficacy. This study was carried out in the Nsukka Education Zone of Enugu State. Nsukka education zone is one of the six education zones in Enugu state. Nsukka education zone is made up of 62 public secondary schools, which comprises of 46 co-educational and 16 single-sex public secondary schools (Post Primary School Management Board, PPSMB Nsukka zone, 2023). Content-wise, the study focused on topics in the SSII first term mathematics scheme of work, namely logarithms, approximations, sequences and series, and quadratic equations. This is because these topics are in the SSII curriculum.

The study participants were 160 (57 males and 103 females) Senior Secondary II students with developmental dyscalculia in Nsukka Education Zone. Multistage sampling procedure was used to select the sample. In the first stage, simple random sampling technique was used to select two LGAs from the three in Nsukka Education Zone. This was to ensure that each LGA has an equal chance of being selected. The Local Government Areas chosen for the study were Nsukka and Igbo Etiti. In the second stage, proportionate



sampling was used to select four co-educational public secondary schools in Nsukka LGA and three co-educational public secondary schools in Igbo-Etiti LGA. The number of schools selected from the 2 LGAs were not equal because the co-educational public secondary schools in Nsukka LGA are more compared to Igbo-Etiti LGA. The third stage involve the purposive sampling of all the SS II students with DD in each selected school. The self-administered questionnaire, Developmental Dyscalculia Identification Scale (DDIS) was used to screen students with DD in the selected schools. The students who had an aggregate score of eight and above on the DDIS were considered to have DD and were used as the sample for the study. This purposive sampling method ensured that the sample only includes SS II students with DD from the two selected LGAs in Nsukka Education Zone.

**Data Collection Instruments and Procedure**

Three instruments used for data collection include Developmental Dyscalculia Identification Scale (DDIS), Mathematics Self-Efficacy Scale (MSES), and Mathematics Achievement Test (MAT). Developmental Dyscalculia Identification Scale (DDIS) consists of 17 items adopted from Schreuder's Dyscalculia Screening Checklist (2010). The instrument is rated on "Yes and No" options where yes = 1 and no = 0. The students were categorized based on the aggregate scores as having DD. The DDIS score ranges from 0 to 17. Students who ticked "yes" to the statements and scored 8 and above were considered to have DD symptoms.

Mathematics Self-Efficacy Scale (MSES) consists of 20 items adapted from Usher and Pajares's Mathematics Self-Efficacy Scale (2009). Mathematics Self-Efficacy Scale (MSES) has sections A and B. Section A contains the demographic information of the students, such as gender, while section B has 20 items rated on a four-point Likert-type scale with response options of: Not at all = 0, Rarely = 1, Occasionally = 2, and Always = 3.

The researcher developed the Mathematics Achievement Test (MAT). It was developed with a table of specifications using the modified Bloom's taxonomy of educational objectives. The MAT covered four topics from the SSII 1st term mathematics

syllabus: logarithms, approximations, sequence and series, and quadratic equations. The instrument consists of 40 multiple-choice items with response options lettered A, B, C, and D. The response options consist of three distracters and a key, which is the correct answer to an item. Each correct answer is worth two marks, while each incorrect answer is worth zero marks.

**Validation of Instrument**

These instruments were subjected to both face and content validation. The face validation was conducted by experts from Mathematics Education, Measurement and Evaluation, and Educational Psychology units within the Faculty of Education at the University of Nigeria, Nsukka (UNN). The experts assessed the instrument's clarity, appropriateness, and item adequacy in measuring its intended constructs. Their feedback, including advice, comments, corrections, and suggestions, contributed to refining the instrument.

**Reliability of the Instrument**

The instruments' reliability was assessed by administering them to 30 SSII Mathematics students not included in the sample. Their scores were then used to calculate internal consistency. The MSES achieved a reliability coefficient of 0.78 using the Cronbach-alpha method, and the MAT attained a reliability coefficient of 0.77 using the Kuder- Richardson (K-R20) formula.

**Data Analysis**

The data for this study was analysed using Statistical Package for Social Science, SPSS version 23.0. Linear regression was utilized to answer research questions 1 while multiple regressions was employed for research questions 2. The benchmark set for decision making on the relationship between the variables was 0.00 to 0.20 (very low), 0.20 to 0.40 (low), 0.40 to 0.60 (medium), 0.60 to 0.80 (high) and 0.80 to 1.00 (very high) (Nwana, 1979). The hypotheses were tested at 0.05 level of significance using ANOVA (regression output) for hypotheses 1 while Fisher's z-score and the associated exact probability value was used to answer hypotheses 2.

**Results**

Table 1: Regression Analysis for the Amount of Variation in the Academic Achievement of Secondary School Students with Developmental Dyscalculia in Mathematics attributed to their Self-efficacy.

Model	N	R	R <sup>2</sup>
1	160	.200 <sup>a</sup>	.040



Table 1 indicates a correlation coefficient (R) of 0.200 between self-efficacy and academic achievement, with a corresponding coefficient of determination (R<sup>2</sup>) of 0.040. This shows that self-efficacy is a significant predictor of academic

achievement of secondary school students with developmental dyscalculia in Mathematics. The coefficient of determination (R<sup>2</sup>) of 0.040 infers that 4% of the variation in academic achievement of secondary school students with DD in Mathematics is attributed to their self-efficacy.

Table 2: ANOVA result for the Variation in the Academic Achievement of Secondary School Students with Developmental Dyscalculia in Mathematics attributed to their Self-Efficacy

Model	Sum of Squares	Df	Mean Square	F	P-value
1 Regression	638.226	1	638.226	6.611	.011
Residual	15252.360	158	96.534		
Total	15890.586	159			

Table 2 shows the variation of academic achievement attributed to self-efficacy. The ANOVA results revealed an F-value and p-value of 6.611 and 0.011, respectively. Since the probability value of 0.011 is less than 0.05 level of significance, the null

hypothesis is rejected. Therefore, the researcher concludes that the amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics that can be attributed to self-efficacy is significant.

Table 3: Model Summary for the amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics that is predicted by self-efficacy, as moderated by gender.

Gender	R	R <sup>2</sup>	Z-value	Sig
Male	.062	.004	-1.08	.2801
Female	.239	.057		

Table 3 shows that correlation coefficients (R) of 0.062 and 0.239 with associated coefficients of determination (R<sup>2</sup>) of 0.004 and 0.057 were obtained for male and female senior secondary school students with DD respectively, between their self-efficacy and academic achievement. These coefficients of determination (R<sup>2</sup>) indicated that 0.4% of the variation in academic achievement was due to self-efficacy for male DD students, while 5.7% was due to self-efficacy for female DD students. The difference in the variation of academic achievement of male and female DD students as correlated with self-efficacy was 5.3%, with females having a higher percentage. This implies that 5.3% of the amount of variation in the academic achievement of DD students that can be attributed to their self-efficacy is moderated by gender.

To test Hypothesis 2, Fisher's Z test was used to test the amount of variation in the academic achievement of secondary school students with developmental dyscalculia in Mathematics that can be predicted by self-efficacy, as moderated by gender. The result as presented in Table 3 indicated that a calculated Fisher's Z-value of -1.08 and an

exact probability value of 0.2801 were obtained. This probability value of 0.2801 was compared with 0.05 set as the level of significance for testing the hypothesis. Since, the exact probability value of 0.2801 is greater than the set level of significance of 0.05; the null hypothesis is not rejected. Therefore, the researcher concludes that the amount of variation in the academic achievement of students with developmental dyscalculia in Mathematics that is predicted by self-efficacy, as moderated by gender is not significant.

### Discussion

The present study demonstrated that self-efficacy is a predictor of the academic achievement of secondary school students with developmental dyscalculia in Mathematics. Specifically, higher self-efficacy among students with developmental dyscalculia is linked to better academic achievement. In other words, students with this learning disability tend to do better academically when they believe they can succeed in tasks involving numbers. The present study finding can therefore imply that students with developmental dyscalculia who believe

in their capacity to attain a set out academic goals are likely to have higher academic achievement than those who do not have such self-belief. It does seem that self-efficacy and academic achievement interact the same way in students with or without a learning disability. Due to the frustration and fear of failure associated with numerical tasks, DD can cause anxiety connected to mathematics. By fostering self-confidence in one's talents, a greater sense of self-worth can help reduce this worry. Students who have developmental dyscalculia frequently experience setbacks and challenges when completing math-related tasks. Higher self-efficacy makes people more resilient when faced with difficulties. Rather than seeing failures as insurmountable challenges, they may see them as chances to grow and learn. Over time, this tenacity may result in higher academic achievement.

This finding agrees with previously published studies. For example, AlAjmi and ALAzemi (2021) reported a positive correlation between self-efficacy and academic achievement among college students in Kuwait. Zaw and Hla (2018) also found that self-efficacy was positively linked to academic achievement of grade 9 students in physics. Another study in India reported that students with high self-efficacy possess high academic achievement (Pavani and Agrawal, 2015). Still, a Ugandan study found a strong positive correlation between self-efficacy and academic performance of undergraduate students (Musa, 2020).

The findings of the study revealed that gender does not moderate the prediction of self-efficacy on the academic achievement of secondary school students with developmental dyscalculia in Mathematics. This finding implies that there is no gender-related significant variance in the relationship between self-efficacy and learning outcomes in Mathematics among this cohort of students with developmental dyscalculia. As a result, teachers and educational initiatives can concentrate on improving self-efficacy without having to modify interventions based on gender. The significance of giving both male and female students with DD similar opportunity and support is emphasized based on the finding of this study. The study finding is consistent with previous studies. For example, Kaur and Kaur (2019) reported that gender does not have any moderating influence on the relationship between self-efficacy and academic achievement. However, in contrast to the present study finding, Kassaw and Astatke (2020) found that gender significantly mediated the relationship between self-efficacy and academic achievement. Male students

had higher self-efficacy and better academic achievement compared to the females. Thus, every student with developmental dyscalculia can benefit from efforts to increase self-efficacy in Mathematics without taking gender into account. It is therefore recommended that school administrators should promote gender-neutral learning environment. A fairer and encouraging learning environment can be achieved by avoiding gender bias and preconceptions in the classroom. Parents should encourage their children with symptoms of DD to express their ideas, worries, and inquiries regarding their mathematical struggles. With this, they will be able to better understand their own difficulties and learning experiences because of this open communication.

### Conclusion

The findings revealed that Self-efficacy is a predictor of the academic achievement of secondary school students with developmental dyscalculia in Mathematics. Additionally, gender is not a moderator variable in the relationship between self-efficacy and academic achievement of secondary school students with developmental dyscalculia in Mathematics.

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