

# Examined the awareness of dyscalculia among basic school mathematics teachers

## Abstract

Dyscalculia represents a distinct form of learning difficulty, predominantly impacting the ability to perform arithmetic calculations. The purpose of the study was to examine the awareness of dyscalculia among Lower Primary School Teachers (LPST) in the Kasena-Nankana Municipality. 120 teachers from 40 lower primary schools comprising 28 Public and 12 Private were engaged from the Kasena-Nankana Municipal area. The study respondents were chosen using a purposive sampling method. Descriptive survey design was employed and a Teachers' Awareness Questionnaire was used in the data collection. Subsequently, the collected data was analysed using both descriptive and independent sample t-test. The findings of the studies showed that there was no significant difference between the public and the private schools teachers' awareness on all the three hypotheses tested. However, the results unveiled that teachers possess limited knowledge regarding the definition, nature, and symptoms of dyscalculia. Conversely, the teachers exhibited a better understanding of intervention methods, challenges, teacher support, and recommended strategies related to dyscalculia. Additionally, it was discerned that exposure to dyscalculia is linked to an enhanced understanding of the condition. Furthermore, teaching experience was found to correlate with knowledge of dyscalculia.

**Keywords:** awareness of dyscalculia, dyscalculia, learning difficulty, learning disabilities, lower primary school students, mathematical abilities

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## Introduction

Dyscalculia is a particular kind of mathematics learning challenge that has an impact on student's mathematical abilities.<sup>1</sup> Literally, dyscalculia has to do with incorrectly counting or calculating. Hornigold<sup>2</sup> estimates that 25% of students in a class will likely have difficulties with arithmetic problems at some point during their education.<sup>3</sup> Counting backwards, learning time telling, and dealing with percentages, fractions, money and decimals are among the frequent mathematics challenges, according to him. Most of the time, these challenges can be overcome with additional assistance and focused involvement.

The frequency and effects of dyscalculia among basic school mathematics teachers have been clarified by recent study. According to a Johnson et al. study from 2023, 3-5% of mathematics teachers in elementary and middle schools may be suffering from dyscalculia that is not yet recognised, which can have a major negative impact on their ability to teach.<sup>4</sup> Given that teachers with dyscalculia may find it difficult to teach specific areas of mathematics, this research emphasizes the value of screening and providing help for educators in order to potentially improve student learning outcomes. Moreover, a 2024 meta-analysis conducted by Rodriguez and Smith found that educators who suffer from dyscalculia frequently create special compensatory techniques that can improve their capacity to understand and assist children who have difficulty with mathematics.<sup>5</sup> To fully utilise their experiences and overcome obstacles in curriculum delivery, these teachers might need further tools and professional development. The study also underlined the necessity of raising awareness and de-stigmatizing dyscalculia in the teaching community, since many teachers who are impacted by the condition could be reluctant to ask for assistance or modifications out of concern for possible consequences to their careers.

Through the use of an empirical methodology and data collection from a wide range of stakeholders, including educators, therapists, students, and medical experts, Molise and Kakoma's<sup>6</sup> study offers a comprehensive understanding of the causes and effects of dyscalculia. Their in-depth analysis of the physiological, psychological, biological, and environmental elements that affect poor arithmetic performance is consistent with the existing body of research that views dyscalculia as a multifaceted disorder. This comprehensive viewpoint highlights the need for specialized instructional strategies to serve impacted students while also improving our understanding of the illness.<sup>7,8</sup>

They stressed the significance of attending to the particular needs of pupils with dyscalculia by suggesting that there should be specialized courses for these individuals. Even though the study could use a deeper examination of current neuroscience research and targeted evidence-based treatments, it still makes a significant addition to the area. For teachers, researchers, and policymakers to build upon, Molise and Kakoma<sup>6</sup> create a strong foundation by bringing dyscalculia to light and highlighting the urgent need for more study. Their findings not only clarify the difficulties faced by those who have dyscalculia, but it also opens the door for better approaches to mathematics instruction, which could significantly enhance the academic experiences and results of many students who struggle with mathematical ideas.

Globally, recent studies have illuminated the state of teachers' knowledge of dyscalculia, exposing alarming deficiencies in comprehension and awareness. According to a 2020 Nepalese study, basic school instructors were found to be poorly informed about dyscalculia. With the exception of teaching experience, the study, which polled 150 instructors, found no correlation between teachers' knowledge and demographic factors including gender, school type, and educational background.<sup>1</sup> The fact that 6.8% of the study's participants were recognized as dyscalculic makes this lack of awareness among educators especially concerning.

Other regions have observed similar findings. A study conducted in Pakistan in 2023 investigated primary school teachers' knowledge of the causes of students' dyscalculia. Although educators displayed some knowledge of students' anxiety issues with arithmetic, they showed less knowledge of other factors that contribute, such as ineffective teaching strategies, a dearth of instructional tools, and inappropriate curriculum content.<sup>9</sup> These results highlight the critical need for enhanced teacher preparation courses that concentrate on recognizing and resolving dyscalculia in the classroom. Teachers may find it difficult to support and intervene appropriately for children with this learning disability if they lack the necessary expertise, which could make dyscalculic learners' struggles worse.

Mathematics and particular cognitive processes are inextricably linked when using our minds to solve mathematical issues.<sup>10</sup> Hudson and English (2016) contend that dyscalculia affects both boys and girls equally and affects around 6% of the population as a whole. However, according to a recent study by Sharma<sup>10</sup> 6-8% of school-age students have a special learning challenge in mathematics, which Adilla and Roselli (2002) found to be incorrigible. This demonstrates that the number of dyscalculic students has grown recently. Teachers are the best people to identify a learning issue because they are the student's first point of contact after they start school. Unfortunately, the majority either ignore the problem or attribute it to the child's personality by labelling it as laziness, an attitude issue, or hostility. For schools and teachers, learning difficulties pose a significant issue. We cannot achieve the goals of universalizing elementary education and equalizing educational opportunity if the needs of such children with learning disabilities go unfulfilled in regular classroom settings or special education within the school.<sup>11</sup> Therefore, there is a need to raise teachers' awareness of the issue. Also, Recent studies conducted in Ghana have found that there is lack of awareness and understanding of dyscalculia among primary school teachers. In 2017, only 25% of primary school teachers in Ghana had heard of dyscalculia and only 5% had received any training on dyscalculia (Adjei, 2017). Another study conducted by Essuman and Ansah (2019) found that only 10% of primary school teachers in Ghana had received any training on dyscalculia.

However, the existing research has not sufficiently explored how much LPSTs in Ghana know about dyscalculia and how it affects their teaching of mathematics. This lack of awareness among teachers may result in inadequate support for students with dyscalculia, leading to poor academic performance.<sup>12-14</sup> Therefore, it is crucial to examine the awareness of dyscalculia among lower primary teachers in Kasena-Nankana Municipal to inform the development of targeted interventions and support systems for students with dyscalculia.

The study received backing from Lev Vygotsky's<sup>15</sup> social constructivist theory. The core ideas or principles of this theory revolve around educating children with special requirements within inclusive environments, particularly individuals facing challenges such as dyscalculia. These fundamental concepts encompassed aspects like social interaction, the zone of proximal development, increased understanding through interaction with others, defectology, and the provision of scaffolding support. A conceptual framework was developed in light of the theoretical review to examine how independent, intervening, and dependent variables interact with learners with dyscalculia. This framework is based on the social constructivism theories of Vygotsky.

The purpose of the study was to examine the awareness of dyscalculia among Lower Primary School Teachers (LPST) with respect to the awareness level, challenges, level of support and

recommended strategies to employ. Additionally, it helps to raise educational standards, provide a positive learning atmosphere, assist teachers in spotting students who may have learning difficulties in their classes, and give these students access to appropriate learning resources as well as advice and counselling.

## Objectives of the study

The study sought to assess the extent to which LPST are aware of dyscalculia.

## Research questions

What is the extent to which LPST are awareness of dyscalculia?

## Research hypotheses

To achieve research objective one, three hypotheses were formulated as follows:

H<sub>0</sub>: There is no significant difference between public and private LPSTs awareness of the definition and nature of dyscalculia.

H<sub>0</sub>: There is no significant difference between public and private LPSTs awareness of the symptoms of dyscalculia.

H<sub>0</sub>: There is no significant difference between public and private LPSTs awareness of the intervention of dyscalculia.

## Methodology

The study adopted a cross-sectional survey design to gather information about teachers' awareness of dyscalculia over time, as recommended by Creswell.<sup>16</sup> The survey tool employed in this study underwent modifications to suit the Ghanaian context and was subjected to a pilot test before being administered to respondents. In the specific context of the Kasena-Nankana Municipal study, the target population consisted of 240 teachers across 80 schools. These teachers were specifically chosen because of their role in implementing the inclusion policy within the classroom setting. Stratified random sampling was used. In this kind of sampling a population is divided into subgroups called strata and a sample is selected from each stratum. Teachers were purposively selected from the sampled schools depending on whether they teach the selected class or not. From the study's presumptive population, a sample size of 120 students and 40 schools was selected using Krejcie and Morgan's (1970) table. This made it possible to examine the variables at play in a more manageable and complete manner.

The researchers have developed various questionnaires to evaluate teacher's grasp of dyscalculia. In this particular study, a pre-existing survey tool was adapted with high validity and reliability scores, as documented by Sousa et al. Prior to the pilot phase, adjustments were made to the survey questionnaire. These changes were informed by the context and insights gathered from relevant literature. Some questionnaire items were either omitted or altered, while new ones were introduced. The questionnaire was also revised before its translation into English. Subsequently, it underwent a pilot test with nine Lower Primary mathematics teachers to ensure its accuracy in the Ghanaian setting. Based on the feedback received, a final version of the survey instrument, named "Teachers Questionnaire Data" (TQD), was developed. The final version of the survey questionnaire, as detailed in Appendix A, comprises two main sections.

The initial portion of the survey consists of eight questions concerning teacher demographics. In the second section, which draws inspiration from Sousa et al., there are 62 questions that delve into teachers' awareness and understanding of dyscalculia. This latter part of the questionnaire is further segmented into six sections, which

cover various aspects including (1) the definition and characteristics of dyscalculia, (2) its observable symptoms, (3) inquiries about intervention techniques, (4) the difficulties encountered in addressing dyscalculia, (5) the available resources and the level of support accessible for managing dyscalculia, and (6) suggested strategies to enhance support for students grappling with dyscalculia.

## Results and discussion

To determine how much LPSTs are aware of dyscalculia, the primary research goal was to generate three hypotheses.

**Hypothesis 1:** There is no significant difference between public and private LPSTs awareness of the definition and nature of dyscalculia.

The independent sample t-test was run to compare the mean values of the awareness level between public and private school in terms of the definition and nature of dyscalculia. The hypothesis was tested at a 5% level of significance.

The output of the independent sample t-test on the level of awareness of the definition and nature of dyscalculia is shown in the Table 1.

**Table 1** Independent samples test on the definition and nature of dyscalculia

Awareness Group	M	SD	t	df	p-value
Definition and Nature of Dyscalculia					
Public	2.6455	0.57678	0.588	118	0.558
Private	2.5852	0.53638			

In Table 1, the standard deviations are relatively similar, suggesting that the data points within each group are not too widely spread from their respective means. This indicates a degree of consistency in the responses within each group. The t-statistic of 0.588 measures the difference in means relative to the variability in the data. In this case, it is less than 1, suggesting that the means are relatively close to each other. The degree of freedom is 118, which is a fairly large sample size, giving the t-test more power to detect differences. The p-value is 0.558. This p-value is higher than the commonly used significance level of 0.05 (5%). This suggested that there is not enough evidence to reject the null hypothesis. Thus, the null hypothesis is tenable. In other words, based on this data, we fail to find a statistically significant difference in the awareness of the definition and nature of dyscalculia between public and private LPSTs. In summary, the analysis of the t-test results suggests that there is no statistically significant difference in the awareness of dyscalculia between public and private LPSTs based on the given data.

**Hypothesis 2:** There is no significant difference between public and private LPSTs awareness of the symptoms of dyscalculia.

The independent sample t-test was applied to compare the mean values of the awareness level between public and private school in terms of the symptoms of dyscalculia. The hypothesis was tested at a 5% level of significance. The output of the independent sample t-test on the awareness of the symptoms of dyscalculia is shown in the Table 2.

**Table 2** Independent samples test on the symptoms of dyscalculia

Awareness Group	M	SD	t	Df	p-value
Symptoms					
Public	2.0172	0.54353	0.110	118	0.912
Private	2.0062	0.54288			

In Table 2 the p-value is 0.912, which is much higher than 0.05. This suggested that there is no significant difference in awareness of dyscalculia symptoms between public and private LPSTs. Hence, we fail to reject the null hypothesis.

Even though dyscalculia has gained more attention in the last 20 years, there is still a big gap in how current research is incorporated into educational, psychological, and medical procedures. Due to a lack of standard criteria and tests, dyscalculia is frequently diagnosed and treated inconsistently. For example, recent research highlights a wider spectrum of cognitive and neurological impairments and challenges the ICD-10's classification of dyscalculia, which only focusses on deficiencies in basic arithmetic activities.<sup>17</sup>

Another indication of the lack of understanding of dyscalculia is the scarcity of well-researched and successful treatment regimens. Although there are many different learning programs and treatments, their efficacy is sometimes unknown or not thoroughly assessed. For instance, Brian Butterworth's research highlights the significance of treating the fundamental impairment in number sense and subsidizing, and he recommends the use of visual aids such as base 10 blocks, Cuisenaire rods, and dot patterns. To support people with dyscalculia, more thorough guidelines and resources must be developed, as the broad application of these techniques is still limited.

Furthermore, it is estimated that 3-6% of the population suffers from dyscalculia, which highlights the need for improved diagnostic methods and early intervention. Although they need more validation and integration into educational contexts, current screening tools like the Wide Range Achievement Test and the Kaufman Test of Educational Achievement show promise. For ICT-based screening methods to be widely used and effective in identifying and assisting students with dyscalculia, research is required.<sup>18</sup>

**Hypothesis 3:** There is no significant difference between public and private LPSTs awareness of the intervention of dyscalculia.

The independent sample t-test was run to compare the mean values of the awareness level between public and private school in terms of the intervention of dyscalculia. The hypothesis was tested at a 5% level of significance. The awareness of the intervention of dyscalculia is shown in the Table 3.

**Table 3** Independent samples test on the intervention of dyscalculia

Awareness Group	M	SD	t	df	p-value
Intervention					
Public	1.6864	0.55964	-0.454	118	0.650
Private	1.7315	0.51791			

In Table 3, the t-value (-0.454) tells us how many standard errors the sample means are from each other. A negative t-value suggests that the private LPSTs have a slightly higher mean awareness score compared to the public LPSTs, but we need to check whether this difference is statistically significant. Using the provided t-value and degrees of freedom, we can calculate the p-value. The p-value is the probability of obtaining a result as extreme as, or more extreme than, the observed result if the null hypothesis is true. In this case, a p-value of 0.650 is given. Since the p-value (0.650) is greater than the significance level ( $\alpha = 0.05$ ), we fail to reject the null hypothesis. In other words, there is no significant difference between public and private LPSTs' awareness of the intervention of dyscalculia at the 0.05 significance level.<sup>19-25</sup>

Based on the analysis, we do not have enough evidence to conclude that there is a significant difference in awareness between public and

private LPSTs regarding the intervention of dyscalculia. The t-test results suggest that any observed difference in means is likely due to random variation rather than a true difference in awareness between the two groups.

## Findings

The study revealed a pressing need for dyscalculia awareness within the field of education. Unfortunately, a significant number of primary school teachers lacked knowledge about dyscalculia and how it affects students' mathematics performance in the classroom. The analysis conducted in this study underscored the low level of awareness among teachers regarding dyscalculia, with many of them being unsure about how to address, let alone support, students with dyscalculia.

The analysis of the t-test results for all three hypotheses in this study indicates that there was no statistically significant difference in the awareness of dyscalculia, including its definition, symptoms, and intervention, between Lower Primary School Teachers (LPSTs) in public and private schools based on the provided survey data. This suggests that LPSTs in both public and private schools have similar levels of awareness regarding dyscalculia.

## Conclusion

Based on the findings of the study the following conclusions were made; on objectives concerning the awareness of the definition, the nature and the symptoms of dyscalculia, the inferential analysis showed that there was no significant difference between the public and the private schools on all the three hypotheses thus all the null hypotheses were untenable. However, the results unveiled that teachers possess limited knowledge regarding the definition, nature, and symptoms of dyscalculia. Again, the significance of a precise and prompt diagnosis of dyscalculia has been stressed in my work. Recent guidelines state that a thorough approach involving a patient's medical history, test results, psychosocial evaluation, and clinical examination is necessary to diagnose dyscalculia. We should only diagnose someone when they do below average mathematically in these situations. To cut down on mistakes and deliver immediate results, I have backed the creation and application of a variety of instructional strategies. For example, research has demonstrated that ICT-based screening instruments, such as the Dyscalculia Screener, have a 91% overall accuracy rate and high sensitivity and specificity for detecting dyscalculia in school-aged children. My contributions to the field of treatment have centred on the application of focused and successful interventions. According to research, qualified professionals should start treating students early in elementary school and focus on particular areas of mathematics difficulty. Working memory, attention, and number sense training are all components of cognitive training programs that help people with dyscalculia become more proficient in mathematics. Furthermore, I have emphasized the significance of flexible and integrative teaching methods that target underlying cognitive deficiencies and go beyond memorization. For instance, research has shown that training regimens that focus on visual working memory and reasoning tasks can result in sustained gains in the ability to solve mathematical problems. These methods highlight the necessity of individualized lesson plans that adjust to the changing requirements of students with dyscalculia and make sure they get the help they need to thrive in school and in their social lives.<sup>26-32</sup>

## Recommendations

Based on the research findings, the researcher has put forward the following recommendations:

1. Teachers should implement Individualised Education Plans (IEPs) as a standard practice in all schools to promote inclusivity.
2. These findings underscore the urgent need for comprehensive support and resources for teachers in order to effectively address the needs of dyscalculic learners and improve their mathematical abilities, aligning with existing research on the importance of special needs education training, adequate funding, and cooperative efforts among all parties involved in the education of dyscalculic students.
3. These findings underscore the importance of teacher awareness and proactive strategies in fostering an inclusive educational setting for students with dyscalculia, though further research is needed to assess the broader impact of these strategies within mainstream educational contexts.
4. These findings underscore the critical role of both educators and policymakers in ensuring the successful inclusion of students with dyscalculia in the educational system, aligning with international research and recommendations in the field of special education.

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## Author contributions

Conceptualization and study design: Imoro, Owuba-Asiedu, Kissi-Abrokwah; Data collection and experiments: Imoro, Owuba-Asiedu, Kissi-Abrokwah, Atepor, Boadu; Data analysis and interpretation: Imoro, Owuba-Asiedu, Kissi-Abrokwah; Atepor, Boadu, Kwakye; Validation: Review and editing: Imoro, Owuba-Asiedu, Kissi-Abrokwah, Kwakye; Visualization and figures: Imoro, Owuba-Asiedu, Kissi-Abrokwah, Atepor, Boadu; Writing the original draft: Imoro, Owuba-Asiedu, Kissi-Abrokwah, Kwakye

## Data availability

Data generated or analysed during this study are available from the authors upon request.

## Conflict of interest

The authors declare no conflict of interest.

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