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Rethinking Mathematics Instruction for Students with Mathematical Disabilities in Learning Mathematics in Junior Secondary Schools in Sokoto Metropolis

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Abstract

Mathematics instruction has been given much attention in recent times by scholars, given the problems encountered by students in their attempt to learn mathematics. Mathematics learning disabilities (MLDs) were noticed to be strongly behind some of these problems experienced by students especially at primary and junior secondary school levels of mathematics learning. To get to the root of this problem, in an attempt to have a re-think in mathematics teaching approaches, a certain study approach was developed by the researchers and was named Special Mathematics Teaching Strategy (SMTS) and was compared with Conventional Mathematics Teaching Strategy (CMTS). In an attempt to establish the viability of both teaching approaches, a study was carried out at the junior secondary school level in Sokoto metropolis; in which a sample of 357 students was used. The instrument used is: T&Y Mathematics Achievement Test (T&Y-MAT). Hypothesis raised was tested at 0.05 level of significance. Pretest-posttest experimental design was further employed to establish the difference between the mean performances of students using both strategies. This was done using t-test. The research in the end, found out that the SMTS is a good strategy for teaching students with mathematics disabilities but require teachers' commitment, dedication and perseverance. Lastly, some recommendations were offered as to how this problem could be reduced drastically if this strategy advocated is judiciously utilized.

Keywords: Learning disabilities; Learning strategies; Mathematics.

1. Introduction

In recent years, there have been several calls by scholars on the need for evolving a strategy suitable for teaching mathematics across continuum of mathematics learning from the scratch to the apex, with the aim of addressing a number of learning disabilities associated with learners of mathematics. Some studies emanating from this agitation included but are not limited to that of Geary [1], who reported that children of school going age tend to have cognitive deficit and memory loss that interferes with their ability to learn some concepts in mathematics and whose percentage ranges between 5 and 10 respectively.

However, there are quite a number of mathematics learning disabilities (MLDs) these students are experiencing; for instance, dyscalculia – numerical and arithmetical deficits [2], Down syndrome – genetic cause of intellectual and learning disabilities [3], dyslexia – a learning disability associated with difficulty in word decoding, fluency, rate of reading, rhyming, spelling, vocabulary and written expression [4].

Therefore, in attempt to correct these anomalies in learning mathematics; in order to have a sort of a paradigm shift and a re-think in teaching approach/strategy that will enable teachers to assist learners identified with these disabilities in their learning, the use of a certain teaching strategy is hereby proposed. The strategy is termed Special Mathematics Teaching Strategy (SMTS). The strategy is to be compared with the Conventional Mathematics Teaching Strategy (CMTS) – a strategy considered to be old – fashioned or traditional approach to mathematics teaching.

In SMTS, the emphasis is on interaction between the teacher and the mathematics learner which is expected to be cordial; thereby culminating into proper assimilation of the knowledge by the learners [5], correction of numerical phobia and addressing the identified disability. To achieve this, the teacher is expected to be psychological – so as to understand the learner, social – so as to interact freely with the learner to allow for proper exchange of views and persevere in the teaching art – so as to be diligent in the process of delivery [5]. This is further explained diagrammatically as PSP Model:

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Psychological

⇩

Social

⇩

Perseverance

Similar to Pedagogical Content Knowledge (PCK) model developed by Shulman [6]; whose focus is on content knowledge to be possessed by teacher for him to be effective in instruction, the PSP model, in addition emphasizes on interaction anchored around understanding the psychology of the learner, developing social skills and perseverance in the art of teaching.

2. Literature Review

In a broader context, Learning Disability (LD) was viewed by the Learning Disabilities of Ontario, Learning Disabilities of Ontario [7] as a variety of disorders that affect the acquisition, retention, understanding, organization or use of verbal and/or nonverbal information. These disorders result from impairments in one or more psychological processes related to learning in combination with otherwise average abilities essential for thinking and reasoning. Learning disabilities ranges in severity and invariably interfere with the acquisition and use of one or more of the following skills: oral language (e.g listening, speaking, understanding), reading (e.g decoding, comprehension), written language (e.g spelling, written expression), and mathematics (e.g computation, problem solving). (p. 1)

However, students especially at pre-primary (kindergarten), primary and early secondary school (junior) tend to experience LD in mathematics because of quite a number of reasons, in addition to the ones outlined above as advanced by scholars; which takes a varieties of forms. According to Geary [1], between 5% to 8% of school-age children have some form of memory or cognitive deficit that interferes with their ability to comprehend and learn concepts and procedures in some domains of mathematical problems. This difficulty could be in form of dyslexia, dyscalculia, dysgraphia or Down syndrome for it mostly affects children to mention but a few.

Viewing the concept from another perspective, Aro, Namangala, February, Aro, *et al.* [8] attributed LD in mathematics to be hereditary but maintained that the extent of its influence in learning mathematics remains unclear. It was however maintained that in the literature available on neuropsychology and developmental psychology, difficulties encountered in the process of learning mathematics have been related with extensive syndromes such as the Gerstmann syndrome and Nonverbal Learning Disability (NLD). It is noteworthy at this juncture that making thorough clarification of Gerstmann syndrome is of paramount importance. It is an LD whose characteristics are difficulties in discriminating the fingers of the hand (i.e finger agnosia), in left-right orientation, and in academic skills relating to mathematics and writing.

In learning mathematics therefore, the greatest challenges for students with such LDs identified before are in mastering the skills that are necessary for applying the number system and solving tasks that are spatially-oriented such as geometry. In this regard, it is the aim of this study to bridge the gap that could not be filled by the previous studies conducted having to do with various forms of LDs associated with mathematics learning through the application of SMTS as stated earlier; in the hope of providing a working model/framework suitable for addressing the disabilities so identified.

Undoubtedly, learners face problems in the process of learning mathematics which is attributed to a number of conditions. While some consider it to be environmental [9], others hold other opinions. To Zentall [10] for example, learning disabilities come to learners in form of attention to the knowledge that the classroom teacher is trying to impart; which according to him, requires absolute attention of the learner. In his take, Lyon [11], regarding learning disabilities (LD), has the following words as his submission:

> LD is not a single disorder, but includes disabilities in any of seven areas related to reading, language and mathematics. These separate types of learning disabilities frequently co-occur with one another and with social skill deficits and emotional or behavioural disorders. Most of the available information on concerning learning disabilities relates to reading disabilities and the majority of children with learning disabilities have their primary deficits in basic reading skills

Therefore, it can generally be considered that LD must be as a result of a certain condition(s) that a learner is said to be suffering from. Such condition(s) manifest in so many ways and conditions and could be as result of number of factors. Few of such conditions are dyslexia, dyscalculia, dysgraphia and Down syndrome. Children (learners) considered to be vulnerable in this respect were found to be lacking the ability to use four arithmetic operations (addition, subtraction, multiplication, division) effectively. This was elaborately captured by Mundia [12] after investigating the problem MLD with a Grade-4 child in the following words:

> Inability to use the four arithmetic operations (addition, subtraction, multiplication, division) efficiently; not understanding the relationship between units, tens and hundreds; using any two of the four arithmetic processes (+, - , x, ÷) in combination within one operation; treating each column as a separate problem; place value problems / wrong alignment of numbers; poor eye-hand coordination leading to dysgraphia; and memory lapses. The other problems that became apparent through this investigation and implied in the findings include possible causal factors such as dyscalculia, dyslexia, low self-esteem, low self-efficacy, and math anxiety.

It should be noted that these are few out of many literatures written on learning disabilities and their corresponding consequences on mathematics learning.

2.1. Statement of the Problem

Over the years, mathematics educators have been confronted with the issue of instructional approach/strategy suitable for teaching mathematics at various levels of its learning. This is further escalated by the discovery of yet some other learning disabilities; thereby compounding the situation and making it even more compelling to evolve means and strategies capable of reducing, if not completely eradicating the problem. It is however argued by Baumslag [13] that mathematics teaching is on the threshold of revolution in its practice because in addition to new technology that has evolved, there is need of new methods of teaching and lecturing skills in the reasonably foreseeable future.

Therefore, re-thinking of teaching strategy suitable for meeting this challenge in an attempt to address this problem is imperative and timely, giving the fact that the problem of learning mathematics is largely attributed to lack of proper instructional strategy by the teachers, who are said to lacking in instructional prowess.

2.2. Objective of the Study

1. To determine the mean difference between performance of pupils with MLDs taught using STMS and those taught using CMTS

2.3. Research Question

1. What is the difference between mean performance of pupils with MLDs taught using SMTS (Posttest – Experimental Group) and those taught using CMTS (Pretest – Control Group)

2.4. Research Hypothesis

$H_{o:}$ There is no significant difference between the mean performance of pupils taught using SMTS (Posttest – Experimental Group) and CMTS (Pretest – Control Group) in teaching students with MLDs.

2.5. Population, Sample and Sampling Technique

The population of the study consisted of all junior secondary school students of Sokoto metropolis numbering about 5,000 i.e ($N = 5000$) out of which a sample of 357 i.e. ($n = 357$) was randomly selected for the study as advocated by Morgan and Krejcie [14]. Out of the sampled students, 180 i.e. ($n_1 = 180$) were male students and 175 i.e. ($n_2 = 175$) were female students.

2.6. Instrumentation

The instrument used in the study is: T&Y Mathematics Achievement Test (T&Y-MAT).

2.7. Research Design

Since the research involves test administration, experimental research design involving pretest – posttest approach was employed; whereby pretest was administered to the students with MLDs and later after the treatment i.e. (SMTS) for six weeks, posttest was administered and eventually the results were compared.

2.8. Results

$H_{o1:}$ There is no significant difference between the mean performance of pupils taught using SMTS (Posttest – Experimental Group) and CMTS (Pretest – Control Group) in teaching students with MLDs.

Pupils	**N**	**Mean**	**std dev**	**df**	**t_{cal}**	**t_{tab}**	**d ecision**
Pretest	150	4.20	10.05				
				348	4.93	1.96	Significant
Posttes	200	5.10	12.275				

Level of Significance = 0.05

The result obtained in the table above indicates that there is a difference between pretest and posttest result. The means that the treatment given (i.e. SMTS) proves to be more significant and impacts on the performance of students. This is because t_{cal} obtained is found to be greater than $t_{tab.}$ In this regard, the statement that there is no significant difference between mean performance of students taught with SMTS and those taught with CMTS is hereby rejected. It clearly indicates that there is a difference between the two strategies.

3. Discussions

The study was conducted to serve as a medium through which students suffering from mathematics learning disabilities could be assisted to learn mathematics with ease. In order to achieve this, SMTS was used as a strategy in teaching students with the disabilities as against the CMTS that has been in operation for decades, used by mathematics teachers in the process of their teaching. In the end, the SMTS was found to be a very good strategy in teaching mathematics to students identified with learning disabilities. This study is similar to that of Geary, *et al.* [15] whose focus was on mathematics and word reading achievement for children with mathematics learning

disabilities. While this study focused on some factors to determine the severity level of learning disabilities in mathematics and low achievement level, the current study focuses on mathematics teaching strategy and its influence on students' achievement in mathematics after suffering from a certain learning disability.

4. Conclusion

Since there is a growing need for evolving mathematics teaching strategy that is capable testing the test of time, there is need to focus attention on some new teaching strategies so as to witness a shift from old-fashioned strategies to mathematics teaching to new ones. To do this, the application of SMTS is hereby strongly advocated. It is a strategy, as stated above that is capable of making the process of teaching mathematics enjoyable, understandable and child-centered. Though, CMTS can still be useful and applicable in some situations, but there is need replacing it with more recent approaches and strategies.

Recommendations

In line with the findings of the study, the following recommendations were offered:

1. The application of SMTS should be employed, especially at primary school that is considered very crucial for learning mathematics.
2. Teachers should be encouraged to be attending workshops, seminars and conferences to enable them become abreast with the current trends of teaching strategies globally.
3. Identifying learners with special needs; who may be require adequate attention by the teacher is imperative. Only then can a teacher apply SMTS appropriately.

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