Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.4, No.8, 2013

Investigating and Remediating Gender Difference in Mathematics Performance among Dyslexic and Dyscalculic Learners in Sokoto State, Nigeria.

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Abstract
This study investigated and remediated gender difference in Mathematics performance among dyslexic and dyscalculic learners in Sokoto State. A sample of eight hundred and twenty seven (827) students at Junior Secondary Schools was used, comprising of four hundred and twenty three (423) males and four hundred and four (404) females. The data collected was computed using Statistical Package for the Social Scientists (SPSS) version 19. Mean scores, standard deviations, and t-test were employed at significance level of 0.05. The scores for the experimental groups increased by 54.49%, while the scores for the control groups decreased by 0.3% after remediation. The findings indicated that the treatment given on the experimental groups was significantly effective on dyslexic and dyscalculic students and confirmed no gender difference in academic performances at both pre-test and post-test levels. The study recommended that investigation and remediation of dyslexic and dyscalculic students should always be carried out by teachers and be seen as a special tool for reducing the level of difficulties as well preventing the existence of gender difference among students in mathematics.
Keywords: Investigating, Gender Difference, Dyslexia, Dyscalculia, and Remediation

1. Introduction

The controversy that exists in Mathematics classroom in terms of gender when it comes to performance is still unresolved. The gender differentiation began since the Seventies when quantitative research was considered as an independent variable that determined the different kind of Mathematical skills and knowledge that both men and women possessed, based on their performance in this area. The results of these studies confirmed small differences between men and women or boys and girls (Atweh, 1995).

However, Santos, Ursini, Ramirez and Sanchez (2006) reported that in the nineties, the need to consider other theories and methods to examine gender difference became apparent. Attention has been shifted to the social and cultural processes that boys and girls are subjected to, which affect their Mathematics achievement, participation and performance. Nonetheless, the consideration that gender and sex are not synonymous still holds among researchers and psychologist. According to (Lamas, 1986, Bustos, 1991:1994, Gomariz 1992, Barbieri, 1996 and Scott, 1996). Gender is a socio-cultural construct a category that sorts and organizes social relationships between human male and female. Gender acquisitions develop through a complex, individual social process. Sex by contrast, refers to anatomical and physiological characteristics deriving from biology (Santos, Ursani, Raminez and Sanchez (2006). However, learning difficulties in Mathematics are frequently identified via poor performance on a standardizing achievement test. This is row related to Gender to identify who performed better and vice-versa.

Today, gender differences in learning Mathematics continue to be a focus of interest and majority of studies study that there is a communal belief that males are better in Mathematics (Yazici and Ertekin, 2010). Identifying the factors responsible for the gender difference in Mathematics performance. Felson and Trudeau (1991) reported the findings of (Boswell, 1980; Brush, 1980; Eccles and Jacob 1986; Finn and Person, 1986) who confirmed socialization to be responsible for the gender difference in Mathematics favouring males. However, Fennema and Leder (1990) Identified differential teacher interactions with boys and girls. They are of the views that teachers interact more with boys than girls, praise and scold boys more than girls, and call on boys more than girls. In spite of all these evidences, the impact of their differential treatment is unclear and uncertain.

Yet, the data collected from these teachers treatment of boys and girls causes gender differences in Mathematics.

The student's inability to achieve his/her potentials is due to what researchers, educationists and psychologists termed as learning difficulty. The word learning difficulties is used to describe symptoms that are displayed by learners, which include problems with listening, processing information, reading, writing, speaking, spelling and mathematical calculation.

While Sharma (2008) believes that children experience Mathematics learning difficulties for a variety of reasons such as dyscalculia, dyslexia, cognitive delay, delay in development of the basic keys of mathematics milestones, poor preparation in prerequisite skills and inappropriate learning experiences.

- Intervention to be a plan of action implemented by an instructor on behalf of students who may need extra help or acceleration. In intervention process, students difficulties or strengths are identified at early stages while supposed weaknesses are quickly addressed before they become problem for the students.
- Remediation is the actions taken to reverse established patterns of performance by students who are already struggling or failing to achieve success in Mathematics and who need intensive, long or short term help. This involves supplementary instruction on content in which students should have mastered but have not.

Also, Yang (2003) conducts an intervention study of the fifth grade students in Taiwan using number sense activities. Yang's findings confirmed statistically significant difference at 0.01 level of significance, after instruction, between the pre-test and post-test scores. The experimental class increased its mean score from 12.33 to 17.81 (44%) and the control class only increased its mean score from 11.29 to 12.42 (10%). This is an indicative of the fact that carefully planned intervention measures could produce good results.

Galadima (1988), Westwood (2000) and Carnellor (2004) call for remedial classes in the identified areas of difficulties after they had found difficulties in solving equation involving difference of two squares, cross-multiplication and solving equation using the methods of elimination and substitution, graph, variation and computational problems among Junior Secondary School level.

Brain (1999:01) further states that:

> Dyscalculic learners may have difficulty understanding simple number concepts, lack an intuitive grasp of numbers and have problems learning number facts and procedures. Even if they produce a correct answer or use a correct method, they may do so mechanically and without confidence. Very little is known about the prevalence of dyscalculia, its causes or treatment. Most dyscalculic learners will have cognitive and language abilities in the normal range and may excel in non-mathematical subjects.

Westwood (2000:18) believes that:

> One of the main problems encountered by students…..is translating between their own intuitive and concrete understanding of the real world and the language used to describe and quantify Mathematical purposes for school.

Exemplifying students' difficulties in Mathematics, Yusha'u (2006) cited Howell (2000) who categorized mathematics difficulties into two broad categories of learning disabilities: mathematics computational disabilities and mathematical reasoning disabilities. Both are characteristics of dyscalculia and these categories are based on the child's performance in classroom which is the outcome of his or her learning differences.

However, Sharma and Brazil (1997) define dyscalculia to be that inability to conceptualize numbers, number relationships (arithmetic facts) and outcomes of numerical operations (estimating the answers to numerical problems before actually calculating). Relating dyscalculia with dyslexia, Sharma & Brazil (1997) wrote:

- Dyscalculia is proving to be more widespread than dyslexia.
- Although some dyslexic have similar problems with sequencing and organization, the problem of the dyscalculic stem from the language concepts and the procedures of mathematics.
- Dyscalculia has two (2) categories of origin: 1) Neurological / Cognitive & 2) Environmental /Physiological.
- Environmental factors include individual's mathematics learning ability, presence or absence of prerequisite skills, adequate development of mathematical language and teaching methods. They also advocate for appropriate teaching methods to match the student's needs so as to achieve the desired progress.

Based on the foregoing discussion about the definitions and the characteristics of dyslexic and

dyscalculic (slow learners). The researcher wants to believe that every mathematics teacher has a daunting challenges of facing and teaching at least more than 10 to 15 slow learners who are either dyslexics or dyscalculics or both in his mathematics classroom. Yusha'u (2006) thus recommended that:

- Diagnosis of students' learning difficulties should be carried out topic by topic wise and remediation should be given immediately after the difficulties have been identified.
- Methodologies of classroom presentation should be varied and used interchangeably; teachers should not stick to one methodology.
- Teachers should always provide remedial class for the difficult exercises and assignments given in the classroom, to the students that are below the average mean scores. From the above backdrop, one can say that the remediation of slow learners dyslexia and dyscalculia in Junior Secondary Schools of Sokoto State is necessary to improve the students' interest and performance in mathematics to the desired level.

2. *Statement of the Problem*

It is perceived that there exist gender differences in mathematics performance and at every level of learning. However, there are quite a number of factors which can basically affect the learning of mathematics. These may occur independently or may interact to create a potential learning difficulty. Each and every person is an independent individual and may have a combination of different level of severity learning difficulties of these factors. Though with appropriate help, most of the difficulties associated with these factors can be alleviated or circumvented (Chinn, 2004). Galadima (1988) while researching on comparative performance by gender in subtopics of Junior secondary school Algebra in Sokoto State found out that, both boys and girls have difficulties in solving equation involving difference of two squares, cross-multiplication and solving equation using the methods of elimination and substitution. Graph and variation were also found to have posed some difficulties to Junior Secondary School – three students.

Also in Sokoto State, Yusha'u (2004) diagnosed and remediated mathematics learning difficulties among Senior Secondary School students. The results from the diagnostic test revealed that more than 75% of the students have difficulties in the areas of Algebra, Trigonometry and Statistics as a result of lack of proper understanding of the basic concepts, principles, terms and symbols. The study also confirmed equal level of difficulties and performance

Galadima and Yusha'u (2007) investigated the mathematics performance of Senior Secondary School students in Sokoto State. The findings revealed the existence of learning difficulties in mathematics and confirmed no gender difference in performance. Recently, Adaramola (2012) confirmed significant gender difference after investigating the effects of concept mapping on performance and interest of students with dyscalculia in secondary school mathematics in Nigeria

It is against this background this study aims at finding out whether a remediation programme would have significant impact on slow learners' dyslexia and dyscalculia in learning Mathematics at Junior Secondary School level in Sokoto State.

3. *Objectives of the Study*

The main objectives of this study are:

- To identify gender difference in the prevalence of learning difficulties among dyslexic and dyscalculic (slow learners) in learning mathematics.
- To design remedial instructions that could best address, alleviate and circumvent slow learners dyslexia and dyscalculia mathematics learning difficulties
- To remediate the slow learners' dyslexia and dyscalculia mathematics learning difficulties at Junior Secondary School level

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- To restore the confidence of dyslexic and dyscalculic (slow learners) in learning mathematics.

4. *Research Questions*

- Is there any significant gender difference in the prevalence of slow learning among dyslexic and dyscalculic (slow learners) before remediation?
- Is there any significant difference in the academic performance of the experimental groups between gender dyslexic and dyscalculic (slow learners) after remediation?

5. *Research Hypotheses*

- There is no significant gender difference in the prevalence of slow learning among dyslexic and dyscalculic (slow learners) before remediation.
- There is no significant difference in the academic performance of the experimental groups between gender dyslexic and dyscalculic (slow learners) after remediation.

METHODOLOGY

6. *Research type*

The study employed quasi-experimental design using a pre-test and post-test method. Remedial instructions were designed and given for a period of 12 weeks. The target population of this study was all the students of junior secondary school II of Sokoto state who were found to be slow learners and characterized as dyslexics and dyscalculics in mathematics

7. *Sample and Sampling Techniques*

The result of the survey conducted by the researcher to find out dyslexic and dyscalculic (slow learners) revealed that there were students in Junior Secondary Schools of Sokoto State who satisfied this condition. Therefore, the sample of all the students was taken which was in accordance with the advice of (Fox, 1969 and Patton, 1990) on purposeful sampling technique. that subjects are selected because of some learning characteristics from highly unusual manifestation of interest as a result of outstanding success or failures. However, two (2) main categories of schools were chosen: (1) Boys schools, (2) Girls schools.

To arrive at the above, examination results of the sampled students were collected from the selected schools. The last 15 - 20 students from the examination list of classes of JSS II who scored below average were purposefully selected. Hence, a sample of eight hundred and twenty seven (827) students at Junior Secondary Schools was used, comprising of four hundred and twenty three (423) males and four hundred and four (404) females in accordance with Morgan and krejcie (1971)

8. *Instruments*

The instruments used in carrying out this study were;

(i) Sakkwato Mastery Learning Mathematics Programme of Instructions (SMLMPI) for experimental groups; and

(ii) Sakkwato Mathematics Achievement Test (SMAT) for the pre-test and post- test.

9. *Sakkwato Mastery Learning Mathematics Programme of Instruction (SMLMPI)*

The SMLMPI is a mathematics learning instruction package developed by the researcher in order to systematize mastery learning as the instructional approach to handle slow learners' mathematical problems. It consists of units as topics based on Junior Secondary School (JSS) curriculum. Questions were selected from both the National Examination Council of Nigeria (NECO), Junior Secondary Leaving Certification Examination (JSLCE) and Usmanu Danfodiyo University Model Secondary School (UDUMSS) terminal examinations: (1) Which the researchers provided solutions to them . (2) To serve as teachers' instructional guide, students class works and assignments.

According to the developers of the models of mastery learning it is most useful with basic skills and slow learners. As theoretician and promulgator of mastery learning, Bloom (1968) made a number of specific predictions about the gains from mastery learning procedures, i.e. 95% of the students will achieve at the level previously reached by the top 5%. Bloom also suggested that the effect of mastery learning will be largest in Mathematics and Science since learning in these subject areas is generally more highly ordered and sequential (Guskey and Gates, 1986). The SMLMPI was given to experts in Mathematics Education, Measurement and Curriculum Evaluation to assess its face validity. However, the designed Sakkwato Mastery Learning Mathematics Programme of Instruction (SMLMPI) was used in remediating the experimental groups for a period of 12 weeks.

10. *Sakkwato Mathematics Achievement Test (SMAT)*

The SMAT consist of thirty (30) multiple choice items with five (5) options constructed by the researchers to measure students' performance in SMLMPI. The items in SMAT has been designed to evaluate lower cognitive and higher thinking processes. The 30 item multiple choice questions covered the JSS syllabus as demanded by the Mathematics curriculum. Eighteen (18) of the items are of lower cognitive processes and twelve (12) are of higher thinking processes. The SMAT was designed for both pre-testing and post-testing of students' cognitive achievement before and after remediation. Both, marking scheme and students' answer sheets were provided.

Three experts from Mathematics Education, Measurement and evaluation in Usmanu Danfodiyo University, Sokoto were given the instrument to validate. The reliability of the instruments was established by

using split-half method. Pearson's product moment correlation formula was used to obtain correlation coefficient of 0.81.

11. Results:

The data collected from the field were presented and analyzed below. The hypotheses were taken one at a time:

12. Hypotheses Testing

***Ho_1**: There is no significant gender difference in the prevalence of slow learning among dyslexic and dyscalculic (slow learners) before remediation.*

This hypothesis seeks to establish the prevalence in the level of slow learning among dyslexic and dyscalculic students of Junior Secondary Schools of Sokoto State according to gender. To test this hypothesis, the pre-test mean scores and standard deviations of all the students of the sampled schools by sex (male and female) were computed and presented in Table 1.

13. Table 1: Summary of Descriptive Statistics of Pre-test by Gender Before Remediation.

Level of slow Learning by Gender	N	Mean	Std Deviation	Std Error Mean
Female	404	4.88	2.73	0.14
Male	423	5.21	2.91	0.14

The result in Table 1 provided the descriptive statistics of the pre-test of the sample schools by gender before remediation. The mean score (M_1) of the female students for pre-test was found to be 4.88, and standard deviation (SD_1) 2.73, while the male mean score (M_2) was 5.21 and standard deviation (SD_2) 2.91. The results obtained indicated the male means score was slightly higher than that of the female.

To confirm whether this difference is significant or not, the data was further subjected to Levene's t-test as presented in Table 2.

14. Table 2: Summary of Levene's t-test for Pre-test Before Remediation

Level of Slow Learning before Remediation	Levene's Test for Equality of Variation				
	F	Sig	T	Df	sig (2 tailed)
Equal Variances Assumed	0.704	0.402	-1.684	820	0.092
Equal Variances no Assumed			-1.686	819	0.092

The result in Table 2 showed that there was a significant difference in the level of slow learning between male and female t (820) = -1.68, p =0. 09 < α = 0.05. Based on this finding, the null hypothesis (H_{o1}) was retained confirming that there was no significant difference in the level of slow learning between male and female students before remediation.

***H_{o2}**: There is no significant difference in the academic performance of the experimental groups' between gender dyslexic and dyscalculic (slow learners) after remediation.*

This hypothesis seeks to establish the significant difference in academic performance between male and female dyslexic and dyscalculic (slow learners) who received remedial instruction. To test this hypothesis, the post-test mean scores and standard deviations of the experimental groups by gender (male and female) were computed and presented in Table 3

15. Table 3: Summary of Descriptive Statistics of Experimental Groups Post-test by Gender Scores After Remediation

Variables	N	$\bar{X}$	SD	df	t-value	p-value
Female	286	7.45	4.47 (SD_1)	557	0.65	0.513
Male	273	7.71	4.91 (SD_2)			

The result in Table 3 provided the descriptive statistics of the post-test experimental groups by sex. The means score (M_1) of the female students was found to be 7.45 and standard deviation (SD_1) was 4.47. While the mean score (M_2) of the male students stood at 7.71 and standard deviation (SD_1) was 4.91. The result obtained indicated a slight difference in the mean score with the male mean score slightly greater than that of female. This

difference was further investigated using Levene's test as presented in Table 4.

16. Table 4 : Summary of Levene's t-test of Experimental Groups Post-test by Gender

Experimental Groups Post-test by Gender	**Levene's Test for Equality of Variances**				
	F	**sig**	**T**	**df**	**sig (2-tailed)**
Equal Variances Assumed	2.86	0.092	-0.65	557	0.513
Equal Variances not Assumed			-0.65	546	0.514

The result in Table 4 showed that there was no statistical significant difference between the groups since t (557) = -0.654, $p = 0.51 > \alpha = 0.05$. Based on the results of the Levene's t-test, the null hypothesis H_{o2} was retained confirming no significant gender difference in the academic performance after remediation. This is a clear indication that SMLMPI as a remediation tool works equally well with male and female.

17. Discussion

The findings of this study confirmed no significant difference in the academic performance of the experimental groups' between gender dyslexic and dyscalculic (slow learners) after remediation. This finding supported the findings of Yusha'u (2004) which reported that both boys and girls were equal in performance and face equal levels of learning difficulties in the research on diagnosing and remediating mathematics learning difficulties of Senior Secondary Schools in Sokoto State. The finding also confirmed the findings of Imoko and Agwagah (2006) who confirmed no significant difference in the mean interest scores of boys and girls in Trigonometry in their research on 'Improving Students Interest in Mathematics through the Concept Mapping Technique: A Focus on Gender'. However, the finding contradicted Lassa (1985) who asserts that there exists a sex difference in Mathematics performance of students generally. The result of the current study is also contradictory to both Ibadan and Nassarawa conferences of the Mathematical Association of Nigeria 2008 and 2009 respectively, where female students emerged winners at both senior and junior category of quiz and Olympiad pointing to the fact that gender difference is traceable in performance in Mathematics.

18. Conclusion

From the analysis and interpretation of the data collected, the following conclusions are reached about the study:

- There was no significant gender difference between control and experimental groups before remediation.
- There was no significant gender difference in the level of academic performance after remediation
- The Sakkwato Mastery Learning Mathematics Programme of Instruction (SMLMPI) as a remediation programme of instructions for dyslexic and dyscalculic (slow learners) in Junior Secondary Schools of Sokoto State had assisted in raising their academic performance by 54.49%.
- There was a significant academic improvement of dyslexic and dyscalculic slow learners as a result of the remediation given to them for a period of twelve (12) weeks using the Sokoto Mastery Learning Mathematics Programme of Instructions (SMLMPI)
- The Sokoto Mathematics Performances Test (SMAT) was used for conducting both the pre-test and post-test of the study.

19. Recommendations

Based on the findings of the study, the following recommendations are made for the improvement of students' interests and academic performance in Mathematics.

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- The study recommended that investigation and remediation of dyslexic and dyscalculic students should always be carried out by teachers and be seen as a special tool for reducing the level of difficulties as well preventing the existence of gender difference among students in mathematics.

- School administrators should always encourage teachers to give remediation on difficult topic(s) in Mathematics.
- The study also recommends teachers of Mathematics to teach their students with enthusiasm so that the students will learn enthusiastically. This will promote interest among students.
- The study recommends Mathematics teachers to use teaching and learning materials explicitly during the course of every lesson delivery.

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