DIAGNOSIS AND REMEDIATION OF SENIOR SECONDARY STUDENTS' COMMON LEARNING DIFFICULTIES IN MATHEMATICS FROM CHIEF EXAMINERS' REPORT

Wonu, Nduka
Department of Mathematics/Statistics Faculty of Natural and Applied Sciences
Ignatius Ajuru University of Education, Port Harcourt, **NIGERIA**
&
Zalmon, Ibaan Gogo
Department of Mathematics/Statistics Faculty of Natural and Applied Sciences
Ignatius Ajuru University of Education, Port Harcourt, **NIGERIA**

ABSTRACT

This study was aimed at diagnosing and remediating students' common learning difficulties in senior secondary mathematics from the West African Senior Secondary Certificate Examination (WASSCE) Chief Examiner's report from 2005 to 2014 in Nigeria. The study adopted the expost-facto design. A sample of 13,076,111 students who sat for the May/June WASSCE in general mathematics from 2005 to 2014 was used for the study. The information on the learning difficulties of these students were extracted from ten samples of the annual chief examiner's report in mathematics. A research designed 105 item instrument, Diagnostic and Remediation of Students' Common Learning Difficulties in Mathematics (DRSCLDM) was used to elicit information from students on experienced common mathematics learning difficulties in line with the WASSCE Chief examiners' report from the years 2005 to 2014. The data gathered were analyzed using criterions mean (Commonly Difficult, $\bar{x} < 1.5$ and Not Difficult $\bar{x} \geq 1.5$) and used to answer the research questions that guided the study. Findings from the study indicated that senior secondary students did not have learning difficulties in most topics and concepts under the themes; number and numeration, algebraic processes and statistics while students had common learning difficulty in geometry as majority of them had difficulty in more topics under geometry. Consequently, remedies on the identified area of common learning difficulties in senior secondary mathematics learning themes of number and numeration, algebraic processes, geometry, statistics and introductory calculus were provided. Based on the findings it was recommended among others that diagnostic and remedial teaching and learning strategy be applied by teachers to remediate students' common learning difficulties in mathematics.

Keywords: Diagnosis, Remediation, Common Learning Difficulties, Mathematics, Chief Examiners' Report.

INTRODUCTION

Education in Nigeria is an instrument "par excellence" for effecting national development (FRN, 2004). Therefore, there is need for a functional education for the building of: a free and democratic society; a just and egalitarian society; a united, strong and self-reliant nation; a great and dynamic economy; and a land full of bright opportunities for all citizens. These national developmental goals of our country Nigeria can be achieved with education as a tool. Nigeria economy can become great and dynamic if educational research findings and recommendations are being implemented accordingly. However, different educational

disciplines need to play their role in promoting national development and mathematics education also has its role.

Chado and Bala (2004) stated that the role of mathematics education in the march towards the development and modernization of any society or nation cannot be over-emphasized because of its role for social and economic development. Therefore the quest for national economic, scientific and technological development should be matched with corresponding learning progress in mathematics. The speed of progress in mathematics learning could be slow if students experience learning difficulties. Thus, it is necessary to diagnose and remediate students' common learning difficulties in mathematics.

Learning Difficulty

Learning Difficulty (LD) is an umbrella term for a wide variety of learning problems. LD is not a problem with intelligence or motivation. Students with LD are not lazy or dumb but their brains are simply wired differently. This difference affects how they receive and process information. LD students see, hear and understand things differently. LD is a classification which includes several disorders in which a person has difficulty in learning a particular concept in a typical manner or performing a particular task without the guidance of a peer or a teacher. This disorder can disturb a person to learn as quickly as someone who is not affected by a learning difficulty, but is not indicative of intelligence level. LD is a disorder in which a person needs much effort to learn effectively, caused by an unknown factor or factors that the brain's ability to receive and process information (Akinoso, 2014). Students with LD have serious learning problems in schools but do not fall under other categories of handicap-they are not dump or lazy, they have average or above average intelligence but their brains process information differently (IDEA, 2011). A discrepancy between formally measured student Intelligent Quotient (IQ) and academic achievement is a clear indicator of learning difficulty.

According to Pandit (2000), the following three criteria must be satisfied for a student to have learning difficulties;

i.   Students with LD must have significant discrepancy between their potential and or ability and actual achievement.
ii. Students with LD must have learning problems that cannot be attributed to other handicapping condition, such as blindness or mental retardation.
iii. Students with LD must need special educational services to succeed, services that are not needed by their non-handicapped peers.

Possible causes of LD from literature include poor quality of instruction, poor instructional strategy and non-utilisation of instructional materials for instruction, poor nutrition and health challenge (Akinoso, 2014).

Types of Learning Difficulties

Deficit in any area of information processing can show different learning difficulties and one person can have more than one of these learning difficulties. The different types of learning difficulties are dyscalculia, dyslexia, dysgraphia, dyspraxial, visual processing disorder, disorders of speaking and listening; auditory processing disorder, memory disorder and attention-deficit hyperactivity disorder.

1. **Dyscalculia:** Dyscalculia is a specific learning difficulty in mathematics. Developmental Dyscalculia (DD) is a specific dyscalculia that is characterised by impairments in learning basic arithmetic facts, processing numerical magnitude and performing accurate and fluent calculations. DD is a term used to describe significant difficulties in mathematics that are not due to direct damage of the brain.

2. **Dyslexia:** Difficulty in reading.

3. **Dysgraphia:** Difficulty with handwriting.

4. **Dyspraxial:** Refers to a variety of difficulties with motor skills.

5. **Visual processing disorder:** Difficulty interpreting visual information.

6. **Auditory processing disorder:** Difficulties processing auditory information

7. **Memory disorder:** Difficulties creating and retrieving memories. Students have difficulty remembering facts and figures. They also have difficulty following instructions.

8. **Attention-Deficit Hyperactivity Disorder (ADHD):** Learning difficulties due to inattentiveness, impulses and hyperactivity.

Mathematics Learning Difficulty

Mathematics Learning Difficulty (MLD) is one of the several kinds exhibited learning difficulties. According to Blacke (2003), mathematics learning difficulty is mathematics disorders which cause difficulty in learning mathematics concepts. Diane, (2007) defines MLD as an unexpected mathematics learning problem after a classroom teacher or other trained professional has provided a student with appropriate learning experiences over a period of time. Mathematics LD is sometimes referred to as dyscalculia, which is a severe or complete inability to calculate. Dyscalculia is a term which describe a student who has problems learning mathematics due to mathematical skills disorder. Students having mathematics learning difficulty suffer from numerical, manipulative, thinking, reasoning, process, computational, creative and basic mathematics operational skills disorder.

Akinoso (2014) opined that the largest fraction of the students having mathematics learning difficulties suffer from inadequate preparation and ineffective early education in the underlying basic mathematics operations that are required for mathematics studies at their current level. Pandit (2000) describes students with MLD as those who have problems in mathematics but their intellectual functioning as measured by general mental ability test is average or above average and they have normal hearing and visual acuity, no history of chronic disease, regular attendance in class and there is a significant discrepancy between their potential and actual achievement. Diane (2007) and Paula (2012) attributed learning difficulties in mathematics to deficits in one or more of the following different skill types; incomplete mastery of number facts, computational weakness, difficulty transferring knowledge, making connections, incomplete understanding of the language of mathematics and difficulty comprehending the visual and spatial aspects and perceptual difficulties.

Diagnosis of Mathematics Learning Difficulty

Diagnosis is the identification of the nature and cause of a certain phenomenon. It is a term used in different disciplines with variation in the use of logics, analytics and experience to determine cause and effect. Therefore, diagnosis of mathematics learning difficulty is the identification of the nature, content area, cause and effect of students learning difficulty in mathematics. Diagnostic evaluation is concerned with students' persistent or recurring learning difficulties that are left unsolved by the standard prescription of formative evaluation (Okeye, 1991). It is applied to students with learning difficulties so that the appropriate remedial treatment (teaching) is applied within or outside the classroom to ensure the remediation of the identified learning difficulties. Diagnostic instruments for mathematics learning difficulty includes: test (achievement, intelligence and aptitude test), observation, interview and assessment.

Remediation of Mathematics Learning Difficulty

Remediation is the action of remedy; that is, a medicine or treatment that relieves pain or cures a usually miner illness. It is also a way of solving or correcting a problem. Teachers should apply diagnostic and remedial teaching and learning strategy in mathematics classroom instruction to remediate student mathematics learning difficulties. Mathematics teachers while carrying out instruction in the classroom should diagnose (identify) the peculiarities of each student and the group (class) difficulty. An identified mathematics learning difficulty should not be ignored but rather should be responded to immediately. Sternbery and Grigorenko (1999) posit that learning disabilities vary from person to person. This implies that one person with learning disability may not have the same kind of problem as another person with learning disabilities. Given a classroom situation, individual may have groups with distinct learning disabilities. To remedy mathematics learning difficulties in the secondary school, the following treatment measures should apply;

Mastery Model: By this model, the mathematics teachers should allow learners work at their own level of mastery of the concept. Although this should be done with adequate guidance to avoid killing of time on a particular concepts. The mathematics teacher should endeavour that students gain the fundamental skills before moving into next level of instruction. Students are to be given exercises after every teaching and learning period. They are drilled on each concept taught since drilling will tend to make what they have learnt permanent. The drills should be marked and correction made. The adage that practice makes perfect is upheld in this context.

Direct Instruction: The teacher and learner face-to-face instruction with the use of scripted lesson plan is emphasized because, direct instruction allows the teacher to correct student mistakes immediately, to avoid the internalization of misconceptions which might be difficult to correct later. There should be an established classroom environment that will cater for the rapid paced interaction between the teacher and students. The use of highly-structured and intensive instruction with students frequently assessed in a progressive manner should be employed because it has the ingredient of treating mathematics learning difficulty or disability.

Classroom Adjustment: Having identified the disability in the students, the teacher should further to ascertain those disabilities that can be treated or remedied with classroom

adjustments. The classroom adjustments could take the form of special seating arrangement, alternative or modified assignment, quiet learning environment and modified testing procedures.

Use of Special Learning Equipment/Material

Marcia, Fletcher and Funchs (2007) suggested that the use of special learning equipment can remediate learning disabilities in students. Some of the special materials they listed that can help remediate learning difficulties in mathematics are talking or graphical calculators, books on tapes, television or overhead projectors, and mathematics software such as MATHLAB, MATHEMATICA, CINDARELLA, etc.

Special Education: Students identified of having mathematics learning difficulty can be placed on special education as a means to remediate the learning disability. The special education could be carried out by the classroom teacher if found to be a miner one or the school psychologist or clinical psychologist to administer educational therapy. The special education comes in different forms such as prescribed hours in a resource room with the learning disabled students, placement of the learning disabled student in the resource room to learn with mathematics resource materials all the time and enrolment in a special school for learning disabled students.

Adoption of Active Learning Strategies: The use of teaching and learning strategies that will make the mathematics classroom instruction learner centred and lively should be adopted by teachers. Sidhu (2006) posits that students see mathematics as a dull, dry and uninteresting subject which has no relevant submission to the outside world. This perception alone is enough to disillusion students towards mathematics learning. To remediate students learning difficulties in mathematics, the following active and novel instructional strategies are recommended:
i.   Problem solving learning strategy
ii. Problem-based learning strategy
iii. Peer learning strategy
iv. Laboratory-based learning strategy
v.   Technology-based learning strategy
vi. Cooperative and collaborative learning strategies
vii. Mastery learning strategy
Viii. Inductive and deductive learning strategies etc.

Chief Examiners' Report

Chief examiners' report is an official document prepared by external examination body after every year examination which outlines students' areas of weakness, strength and possible remedial measures in various subjects. The examining team prepares these reports after constructive feedback on candidates' performance in the examinations. The chief examiners' reports provide a general commentary on candidates' performance as well as identifying technical aspects examined in the questions, highlighting good performance and where performance could be improved and particularly examining aspects which caused difficulty and why the difficulties arose. Suggested remedies to the identified learning difficulties are also enshrine in the report.

The chief examiners' reports are essential study resource because it gives useful guidance for future candidates and real insight into what the examiner is looking for in terms of examination performance. Prospective candidates can learn from the chief examiners' reports mistakes that candidates commonly make in examination and how to avoid them. The reports cover the main themes of the paper, information on how the examination is structured, advice on examination technique and potential pitfalls to avoid. There are four external examination bodies in Nigeria namely; the West African Examinations Council (WAEC), the National Business and Technical Examination Council (NECO) and the Joint Admission and Matriculation Board (JAMB). Each of these examining bodies gives the report of the conduct of their annual examination in terms of students performance statistics, areas of weaknesses and strength. But this study investigated students' common learning difficulties in senior secondary mathematics from the WACE Chief examiners' report of the West African Senior Secondary Certificate Examination (WASSCE) from 2005 to 2014 years. WAEC chief examiners' report was chosen simply because it examines senior secondary schools students' performance in Nigeria and other West African countries like Ghana, Sierra-Leone, Gambia and Liberia.

Problem Specification

There is a global recognition and awareness of the important role mathematics play in national development. In Nigeria for instance, the study of mathematics is made compulsory for students in all schools and a credit pass in mathematics is a pre-requisite admission requirement for all courses in tertiary institutions. The percentage of senior secondary school leavers that are not eligible for admission into tertiary institutions each year because of failure in mathematics at the senior school certificate examination is very high. This is evidence in the finding of Charles-Ogan (2004), that from 1991 to 2012 West African Senior Secondary Certificate Examination (WASSCE) in mathematics, an average of 72% of the students fail mathematics with only 28% of them passing at credit level and above.

This performance analysis shows an abysmal performance of students in mathematics for twenty-two examination years. This abysmal performance indicates that majority of students have learning difficulties in mathematics and these difficulties could be common among students'. Therefore, this study seeks to diagnose and remediate senior secondary students' common learning difficulties in mathematics from the WASSCE chief examiners' report from 2005 to 2014.

Aim and Objectives of the Study

The aim of this study is to diagnose and remediate students' common learning difficulties in senior secondary mathematics from WASSCE chief examiners' report. Specifically, the following are the objectives of the study:
1. To diagnose students' common learning difficulties in number and numeration from the WASSCE chief examiners' report.
2. To diagnose students' common learning difficulties in algebraic processes from the WASSCE chief examiner's report.
3. To diagnose students' common learning difficulties in geometry from the WASSCE chief examiner's report.
4. To diagnose students' common learning difficulties in statistics from the WASSCE chief examiner's report.

5. To diagnose students' common learning difficulties in introductory calculus from the WASSCE chief examiner's report.
6. To proffer remedial measures to the diagnosed students' common learning   difficulties
in senior secondary mathematics learning themes of number and numeration,
    algebraic processes, geometry, statistics and introductory calculus.

Research Questions

The following research questions guided the study.
1. What are the students' common learning difficulties in number and numeration from the WASSCE chief examiner's report?
2. What are the students' common learning difficulties in algebraic processes from the WASSCE chief examiner's report?
3. What are the students' common learning difficulties in geometry from the WASSCE chief examiner's report?
4. What are the students' common learning difficulties in statistics from the WASSCE chief examiner's?
5. What are the students' common learning difficulties in introductory calculus from the WASSCE chief examiner's report?
6. How can these commonly diagnosed students' common learning difficulties in senior secondary mathematics learning themes of number and numeration, algebraic processes, geometry, statistics and introductory calculus be remediated?

METHODOLOGY
Design

The study adopted the expost-facto design.

Population, Sample and Sampling Technique

The population of the study consist of all the senior secondary students in Nigeria who sat for the WASSCE in general mathematics from 1955 to 2016. Though the West African Examinations Council (WAEC) was set up in Nigeria in 1952, the Council in conjunction with the University of Cambridge Local Examination syndicate conducted for the first time in Nigeria, the West African School Certificate Examination (WASCE) in December, 1955 (Asuru, 2006).

A sample of 13,076,111 students who sat for the May/June WASSCE in general mathematics from 2005 to 2014 was used for the study. This sample was gotten from existing records. The information on the learning difficulties of these students were extracted from ten samples of the annual chief examiner's report in mathematics.

Instrumentation

A research designed and validated 105-item instrument, Diagnostic and Remediation of Students' Common Learning Difficulties in Mathematics (DRSCLDM) was used to elicit information from students on experienced common mathematics learning difficulties in line with the WASSCE chief examiners' report from the years 2005 to 2014. Test re-test method was used to determine the reliability of the instrument to obtain a coefficient of 0.99. The

instrument was patterned after a modified likert rating scale weighting Difficult (D) as 1 point and Not Difficult (ND) as 2 points.

Data Collection

The chief examiners' reports were collected from WAEC offices and schools in Nigeria and some retrieved from the WAEC web-sites.

Data Analysis

The data gathered were analyzed using criterion mean (Commonly Difficult, $\bar{x} < 1.5$ and Not Difficult, $\bar{x} \geq 1.5$) and used to answer the research questions.

RESULTS

Research Question 1: What are the students' common learning difficulties in number and numeration from the WASSCE chief examiner's report?

Table 1: Students' common learning difficulties in number and numeration from the WASSCE chief examiner's report

S/N	Number and Numeration	Mean $(\bar{x})$	Decision
1	Definitions of Set	2.00	ND
2	Set Theory	1.80	ND
3	Application of Arithmetic Progression and sum of nth terms	2.00	ND
4	Conversion of Number Bases and Indicial equations	2.00	ND
5	Interpreting word problems Adequately,	1.00	CD
6	Fundamental Principles of Arithmetic	1.00	CD
7	Simplification of a given logarithmic expression	2.00	ND
8	Variation	2.00	ND
9	Surds	2.00	ND
10	Logarithms	2.00	ND
11	Indices	2.00	ND
12	Sequence	2.00	ND
13	Determinants	1.00	CD
14	Rational Numbers	1.00	CD
15	Permutation and Combination	1.00	CD
16	Commercial and monetary arithmetic	1.00	CD
17	Laws of Logarithms and Indices	1.50	ND
18	Laws of Logarithms application	1.00	CD
19	Application of the rule of BODMAS, in solving problems	1.00	CD
20	Negative Indices Where they should know that $a^{-2}=1/a^2$	1.00	CD
21	Manipulating Fractions	1.00	CD
22	Simplification of fractions	2.00	ND
23	Simplification of surds	2.00	ND
24	Number Bases	2.00	ND
25	Modular Arithmetic	1.00	CD
26	Applications of the laws of logarithms-converting indices to logarithms	1.00	CD

27	Approximation	2.00	ND
28	Calculation of Arithmetic mean	2.00	ND
	Mean of means (number and numeration as a theme)	1.50	ND

$CD = Commonly\ Difficult,\ \bar{x} < 1.5;\ ND =\ Not\ Difficult,\ \bar{x} \geq 1.5$

From table 1, students' common learning difficulties in number and numeration are:

- Interpreting word problems adequately
- Fundamental principles of arithmetic
- Determinants
- Rational numbers
- Permutation and combination
- Commercial and monetary arithmetic
- Laws of logarithms application
- Application of the rule of BODMAS in solving problems
- Negative indices where they should know that $a^{-2}=1/a^2$
- Manipulating fractions
- Modular arithmetic
- Applications of the laws of logarithms-converting indices to logarithms.

Research Question 2: What are the students' common learning difficulties in algebraic processes from the WASSCE chief examiner's report?

Table 2: Students' common learning difficulties in algebraic processes from the WASSCE chief examiner's report.

S/N	Algebraic processes	Mean $(\bar{x})$	Decision
1	Plotting graphs, reading and recording, correct observations	2.00	ND
2	Identification of the use of column vectors to get the x-axis and y-components of resolved parts of a number of forces acting at a point	2.00	ND
3	Algebraic expansion substitution and opening bracket	2.00	ND
4	Expansion of $(2a+b)^2-(b-2a)^2$	1.00	CD
5	Change of subject of formular	1.50	ND
6	Reading of quadratic graphs	2.00	ND
7	Simplifications of equations	1.33	CD
8	Plotting of quadratic graphs	2.00	ND
9	Simultaneous equations	2.00	ND
10	Estimation of the gradient of a curve	1.00	CD
11	Interpretation of quadratic graphs	1.00	CD
12	Simple factorization	2.00	ND
13	Variations	1.67	ND
14	Manipulations of decimals and fractions	1.00	CD
15	Reading and answering questions from graphs	1.00	CD
16	Algebraic graph	1.00	CD
17	Solution to simple linear inequalities	1.50	ND
	Mean of means (Algebraic processes as a theme)	1.60	ND

$CD = Commonly\ Difficult,\ \bar{x} < 1.5;\ ND =\ Not\ Difficult,\ \bar{x} \geq 1.5$

From table 2, the following are students' common learning difficulties in algebraic processes:
- Expansion of $(2a+b)^2-(b-2a)^2$
- Simplification of equations
- Estimation of the gradient of a curve
- Interpretation of quadratic graphs
- Manipulation of decimals and fractions
- Reading and answering questions from graphs
- Algebraic graph

Research Question 3: What are the students' common learning difficulties in geometry from the WASSCE chief examiners' report?

Table 3: Students' common learning difficulties in geometry from the WASSCE chief examiner's report.

S/N	Geometry	Mean ($\bar{x}$)	Decision
1	Plane geometry- angles at a point	2.00	ND
2	Trigonometric ratios/values of angles 0^0, 30^0, 45^0, 60^0, etc.	1.00	CD
3	Coordinates of a point (p,q) where p, stands for x-coordinate and q stand for y-coordinate	1.00	CD
4	Areas of rectangles and circles	1.00	CD
5	Drawing and reading from graphs	1.33	CD
6	Writing answers to the required degree of accuracy	1.00	CD
7	Mensuration- area of a segment to a circle	2.00	ND
8	Geometry- angles on parallel lines	1.00	CD
9	Completing the table of values and drawing graphs of trigonometric functions	2.00	ND
10	Geometry- circle theorems	1.00	CD
11	Graphs- drawing and reading from ogive	2.00	ND
12	Geometric Progression	2.00	ND
13	Application of sine and cosine rules in bearing	2.00	ND
14	Mensuration of three dimension shapes such as right circular cones	2.00	ND
15	Mensuration- areas of plane and solid shapes	2.00	ND
16	Geometrical construction	1.00	CD
17	Geometry and its applications	1.00	CD
18	Interpretation/solution to word problems	1.00	CD
19	Using the tangent of the difference of two angles, and that of direction cosines, to find the value of an angle between two given vectors	1.00	CD
20	Plotting graphs, choosing scale, and axes labelling	1.00	CD
21	Application of theories and theorems in geometry	1.00	CD
22	Solid shapes, their components and fragments and basic principles required in solving problems on solids	1.00	CD
23	Using the ruler and compasses to construct angles, to bisect a given angle as point to a given line locus of points equidistant from two given lines and to draw the perpendicular from an external	1.00	CD
24	Fundamental principles of mensuration	1.00	CD

25	Problems involving sum of the angles of a pentagon as 5400 in solving the problem on polygon	2.00	ND
26	Trigonometric ratios	2.00	ND
27	Longitude and latitude	1.25	CD
28	Perimeters of circle and sectors	2.00	ND
29	Constructions	1.00	CD
30	Circle theorems	1.00	CD
31	Angle of elevation and depression	1.00	CD
32	Estimation of the gradient of a curve	1.00	CD
33	Areas of a circles, sectors and segment	1.00	CD
34	Bearings	1.50	ND
35	Calculation of angles in a regular/convex polygon	1.00	CD
36	General concepts of principles of calculating angles in circles and polygons	2.00	ND
37	Solid geometry	1.00	CD
	Mean of means (Geometry as a theme)	1.40	CD

CD = Commonly Difficult, $\bar{x} < 1.5$; ND = Not Difficult, $\bar{x} \geq 1.5$

From table 3, the observed common students' learning difficulties in geometry are;
- Trigonometric ratios/values of angles 0^0, 30^0, 45^0, 60^0, etc.
- Coordinates of a point (p,q) where p, stands for x-coordinate and q stand for y-coordinate
- Areas of rectangles and circles
- Drawing and reading from graphs
- Writing answers to the required degree of accuracy
- Geometry –angles on parallel lines
- Geometry- circle theorems
- Geometrical construction
- Geometry and its applications
- Interpretation/solution to word problems
- Using the tangent of the difference of two angles, and that of direction cosines to find the value of an angle between two vectors
- Plotting graphs, choosing scale and axes labelling
- Application of theories and theorems in geometry
- Solid shapes, their components and fragments and basic principles required in solving problems on solids
- Using the ruler and compasses to construct angles, to bisect a given angle as points to a given line locus of point equidistant from two given lines and to draw the perpendicular from an external
- Fundamental principles of mensuration
- Longitude and latitude
- Constructions
- Circle theorems
- Angle of elevation and depression
- Estimation of the gradient of a curve
- Areas of a circles, sectors and segment
- Calculation of angles in a regular/convex polygon
- Solid geometry

- Geometry as a theme

Research Question 4: What are the students' common learning difficulties in statistics from the WASSCE chief examiners' report?

Table 4: Students' common learning difficulties in statistics from the WASSCE chief examiner's report.

S/N	Statistics	Mean $(\bar{x})$	Decision
1	Statistics, probability and the plotting of a cumulative Curve	2.00	ND
2	Setting up of frequency tables and the drawing of histograms	2.00	ND
3	Application of product rule in solving the problem on probability	2.00	ND
4	Construction of the frequency table and drawing of the histogram of the distribution	2.00	ND
5	Use of histogram to estimate the mode	1.00	CD
6	Difference between bar chart and histogram	1.00	CD
7	Measures of central tendency	2.00	ND
8	Pie chart	2.00	ND
9	Use of ogive to estimate quartiles and percentiles	1.00	CD
10	Estimation of median and mean from grouped data	2.00	ND
11	Calculation involving frequency distribution	2.00	ND
12	Probability	1.67	ND
13	Calculation of mean	2.00	ND
14	Standard deviation	1.00	CD
15	Drawing of histogram	2.00	ND
16	Simple probability	2.00	ND
17	Calculation of the mean and standard deviation of grouped data	2.00	ND
18	Representation of information in a diagram	1.00	CD
19	Calculation of median	2.00	ND
20	Completion of the cumulative frequency table and drawing of the ogive	2.00	ND
	Mean of means (Statistics as a theme)	1.70	ND

CD = Commonly Difficult, $\bar{x} < 1.5$; ND = Not Difficult, $\bar{x} \geq 1.5$

From table 4, the observed students' common learning difficulties in statistics from the WASSCE chief examiners' report includes:
- Use of histogram to estimate the mode
- Difference between bar chart and histogram
- Use of ogive to estimate quartiles and percentiles
- Standard deviation

- Representation of information in a diagram

Research Question 5: What are the students' common learning difficulties in Introductory Calculus from the WASSCE chief examiners' report?

Table 5: Students' common learning difficulties in introductory calculus from the WASSCE chief examiners' report.

S/N	Introductory Calculus	Mean$(\bar{x})$	Decision
1	Differentiation	Nil	NT
2	Integration	Nil	NT

CD = Commonly Difficult, $\bar{x} < 1.5$; ND = Not Difficult, $\bar{x} \geq 1.5$, NT = Not Tested

From table 5, it can be observed that students had not been tested or examined in introductory calculus for the period under consideration. The reason could be that the senior secondary mathematics curriculum was recently reviewed to accommodate introductory calculus.

Research Question 6: How can these commonly diagnosed students' learning difficulties in senior secondary mathematics learning themes of number and numeration, algebraic processes, geometry, statistics and introductory calculus be remediated?

Table 6: Summary of suggested remedies for students' common learning difficulties in senior secondary mathematics from the WASSCE chief examiners' report.

S N	Suggested Remedies
1.	Teachers should prepare their lessons very well and deliver effectively, using sufficient and standard teaching aids.
2.	Teachers are further advised to give adequate exercises that would be well marked and corrections to be thoroughly checked.
3.	Principals of schools should encourage experienced teachers to take care of lower classes such as Junior Secondary Class the (JSC1) and Junior Secondary Class two (JSC2) for solid foundation in mathematics.
4.	Government and parents should equip the school libraries with modern mathematics textbooks.
5.	Government and proprietors should encourage their mathematics and science teachers to attend workshops, seminars and refresher courses on regular bases.
6.	Schools should enforce their students to possess mathematical instruments, simple calculators, mathematical and logarithms tables and graphs books for their use especially at the senior secondary classes.
7.	Government and schools should encourage their teachers to attend the WAEC coordination and marking meetings.
8.	Teaching should be learner-centred and oriented using modern instructional techniques and mathematical models. There is an urgent need to recruit more mathematics teachers to cope with the teaming population of student.
9.	The degree and level of assumptions that the teacher made on their candidates during the preparation of some topics of the syllabus should be reduced, especially teachers responsible in the teaching of the final year senior secondary classes.
10.	Teachers should be more dedicated to the teaching of mathematics.

11.   Rekindling of students' interest in mathematics through quiz, drilling etc.
12.   Teachers were encouraged to expose candidates to the application of mathematical concepts to solving problems in their everyday life situations.
13.   Teachers as well as candidates were encouraged to cover all the topics in the syllabus while preparing for the examination.
14.   Qualified teachers should be engaged to teach mathematics.
15.   Teachers were encouraged to use instructional materials during classroom lesson delivery so as to reinforce the learning of mathematical concepts.
16.   Teachers were encouraged to put in more effort at leading the candidates to solving word problems leading to simple algebraic equations.
17.   WAEC was encouraged to set questions in these difficult areas more regularly in order to encourage teachers and candidates to put in more effort in learning them.
18.   Candidates were encouraged to read, understand and adhere strictly to instructions.
19.   Candidates were encouraged to avail themselves of past WASSCE mathematics question papers while examinations.
20.   Candidates should be led to do simple arithmetic without the use of calculators and mathematical table.
21.   Teachers as well as candidates were encouraged to put in more effort to the teaching and learning of geometry and trigonometry.
22.   Attempts should be made to correct the wrong notion among students that mathematics is a difficult subject. This can be done through affective campaigns.
23.   The teacher student ratio in a class should not be more than 1:30.
24.   Motivation and development of teachers through training and re-training as well as provision of adequate teaching and learning materials would ensure qualitative teaching.
25.   Candidates were encouraged to draw diagrams especially where such diagrams would aid in the understanding and solution of a given problem.
26.   Candidates were encouraged to the rubrics of the question especially with regards to the degree of accuracy.
27.   Candidates should be encouraged to read the questions carefully so as to understand its demand before attempting them.
28.   Teachers are encouraged to do frequent revision exercises with the candidates in order to enhance the candidates' retention of the various knowledge and skills gained in previous lessons.

DISCUSSION
Students' Common Learning Difficulties in Number and Numeration

The result from table 1 showed that number and numeration as a theme of the senior secondary mathematics curriculum was not commonly difficult with students (mean of means = 1.50) but students found some aspects of number and numeration commonly difficult to learn. This result agrees with the finding of Wonu and Okpobiri (2012). They investigated the effects of metacognitive learning strategy on the evaluation skills of students with development dyscalculia in number and numeration. The findings indicated that metacognitive learning strategy remediated students' development dyscalculia in number and numeration and hence, improved their performance. The implication of this finding is that, there were students with learning difficulties in number and numeration.

Students' Common Learning Difficulties in Algebraic Processes

The result from table 2 revealed that algebraic processes generally was not commonly difficult among students (mean of means =1.60) though students found some topics, sub-topics and concepts in algebraic processes commonly difficult to learn. The present result is in agreement with the past findings by Brian (2010) Brain maintained that algebra was the areas that many of the students found a little bit difficult to handle. The implication is that secondary school students are encountering some difficulties in learning algebraic processes**.**

Students' Common Learning Difficulties in Geometry

The result obtained in table 3 should that geometry is a commonly difficult learning theme of the senior secondary mathematics curriculum (mean of means =1.40). The present study agreed with the research report of Howel (2000) and WAEC (2007). Howel found out that students have difficulties with mathematical concepts, terms and symbols arising from the realm of mathematical thinking in solving geometry while the West African Examinations Council (WAEC) chief examiner's report on students' areas of strength and weaknesses in senior secondary certificate examinations, revealed that students least understood geometry concepts as shown by their achievement and attitude as they repeatedly fail geometry questions, avoid them or haphazardly attempt them.

Students' Common Learning Difficulties in Statistics

The result in table 4 indicated that statistics was not commonly difficult with students (mean of means = 1.70) however students have difficulties in learning to; use the histogram to estimate the mode, differentiate between bar chart and histogram, estimated quartiles and percentiles using ogive, calculate standard deviation and represent information in a diagram.

Students' Common Learning Difficulties in Introductory Calculus

Although the result in table 5 revealed that students had not been assessed in introductory calculus theme of the general mathematics for the period under consideration but Ifamuyiwa (2014) analysed topics perceived difficult by Nigerian students and teacher in secondary school further mathematics and found out that differential (differentiation) and integral (integration) calculus were difficult to students and even teachers.

CONCLUSION

The study has established that senior secondary students have common learning difficulties in geometry generally and in specific areas of number and numeration, algebraic processes and statistics. From the literature reviewed, introductory calculus was also difficult with students to learn. However, some suggested remedies to the identified students' common learning difficulties in senior secondary mathematics were given for immediate implementation.

RECOMMENDATIONS

The following recommendations have been made based on the finding of the study:

1. Diagnostic and remedial teaching of mathematics should be applied by teachers in classroom instruction. Particularly in the teaching of geometry and introductory calculus.

2. Active learning strategies and laboratory approach should be used to teach geometry in secondary schools.
3. The suggested remedies to the diagnosed students' common learning difficulties in mathematics by the West African Examinations Council (WAEC) chief examiners' report should be strictly implemented by all concerned persons and authorities.

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