INVESTIGATING DIFFICULT CONCEPTS IN SENIOR SECONDARY SCHOOL MATHEMATICS CURRICULUM AS PERCEIVED BY STUDENTS

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ABSTRACT

This study employed the survey research design aimed at investigating difficult concepts in senior secondary school mathematics curriculum as perceived by students in Rivers state. The study was guided by two research questions and the sample for the study was 250 SS3 students. The instrument used for the collection of data was a 31-item questionnaire tagged Difficult Concept Identification Questionnaire in Mathematics (DCIQM). The instrument was validated and the reliability established using the test-retest method. The data obtained were analyzed using mean with the criterion mean set at 2.5.The findings of the study revealed that students identified some mathematics topics (longitude and latitude, bearing mensuration) as difficult topics. Based on the findings of the study, it was recommended amongst others that workshops should be organized to train mathematics teachers on the effective and efficient strategies that should be adopted for the teaching of the identified difficult mathematics concepts.

Keywords: Mathematics, Difficult topics, Curriculum, Students.

INTRODUCTION

Mathematics concepts are vast, interrelated and possess interconnected elements. The interrelationship of mathematical concepts can be identified in the use of elementary operations of division, ratios, percentage, addition, subtraction, translation of word problems and use of symbols across mathematics discourse while the interconnected elements according to Robertson and Wright (2014) are discovery and analysis of pattern, logical reasoning applied to systems and recognition and explanation of the underlying links between these systems. This suggestion exposes the requisite knowledge that underlies difficulty or non-difficulty of mathematics as a subject. Students of low logical reasoning and analytical prowess would, therefore, find certain concepts difficult. These students would have visual or dyslexic-type of difficulty which would inhibit their perception of pattern. In contrast, students of high reasoning ability and high intelligence may show competence in handling some concepts in mathematics but may also view some concepts as difficult.

The term "difficulty of concept" therefore, is not completely the inability of a student to obtain a pass mark in a collection of mathematics problems but what constitutes a 'persistent hitch' and makes procedural approach to cognition of a mathematics concept a hideous task, all the time. In identifying students' difficulties with mathematics concepts, Robertson and Wright (2014) stated that students generally have intrinsic difficulty in mathematical reasoning, mathematical ideas and understanding basic mathematical concepts.

Elif (2003) also mentioned that students experience difficulties in constructing mathematical meanings of symbols. This view was re-emphasized by Hiebert and Carpenter (1992) and Janvier, Giorardon and Morand (1993). The researchers emphatically stated that most of the

difficulty in understanding symbols comes from the fact that the symbols might take on different meanings in different settings.

The conceptual knowledge in mathematics requires adherence to an algorithm that leads the solver through a correct process to a correct answer. During instruction, students should be allowed to actively participate in each step of a problem solving algorithm for formalization and effective practice. Some students' difficulties can be attributed to inappropriate representation and handling of problems, such as fractions, ratio, extrapolation and erroneous algorithm (Silver, 1986; Ben – Zeev, 1996).

Some problems such as mathematics anxiety among students and attitude towards mathematics learning have been identified by researchers to be inherent in students. Mensah, Okyere and Kuranchie (2013) explains that attitude as a concept is concerned with an individual's way of thinking, acting and behaving and has serious implication on the learner. However, Yara (2009) posits that teachers with positive attitude, towards mathematics can stimulate favourable attitudes in their students. The student attitude towards a learning process whether innate or emulated, reshapes his behavior in the classroom and an emotional disposition towards mathematics. Hart (1989) consider attitude toward mathematics from multidimensional perspectives and defined an individuals' attitude toward mathematics as a more complex phenomenon characterized by the emotions that he associates with mathematics; his beliefs about mathematics and how he behaves towards mathematics.
This study is therefore aimed at identifying these difficult topics in senior secondary school mathematics curriculum as perceived by students in Rivers State of Nigeria.

Statement of the Problem

Mathematics plays a key role in shaping how individuals deal with the various spheres of life, be it private, social or cooperate. A cursory look at the national curriculum for mathematics reveals the concepts applicability of the mathematics knowledge in our formal and informal daily activities. Students' of the subject matter have challenges to effectively learn mathematical processes.

The WAEC chief examiners' report has shown that there is over a decade-long poor performance of students in mathematics despite improved teaching methods and motivational learning strategies. This trend is frustrating to students' aspiration for higher education in areas where a credit in mathematics is required and general cognition of the subject. It is therefore, necessary to allow the student indicate what constituted their difficulty in the subject area and the possible cause of such difficulties.

Purpose of the Study

The purpose of the study was to investigate the difficult concepts in senior secondary school mathematics curriculum as perceived by students. Specifically, the objectives of the study are to:

1. Find out the difficult concepts in mathematics in the senior secondary school curriculum as perceived by the students.
2. Ascertain the causes of the identified difficult mathematics concepts in the senior secondary school curriculum as perceived by the students.

Research Questions

The following research questions guided the study:

1. What mathematics concepts do students perceive as difficult in the senior secondary school mathematics curriculum?
2. What are the possible causes of the identified difficult mathematics concepts in the senior secondary school curriculum as perceived by the students?

Methodology

Descriptive survey design was adopted for the study using the Difficult Concept Identification Questionnaire in Mathematics (DCIQM). The sample consisted of two hundred and fifty (250) SS3 students from eight public coeducational senior secondary schools in Rivers State. The instrument was based on the current national mathematics curriculum for senior secondary school. DCIQM was researcher constructed and made up of two sections, A and B. Section A measured the difficult mathematics concepts as perceived by students while section B measured the possible causes of the identified concept difficulty. Section A was made up of twenty one items on a 4-point scale of Very Difficult =4, Difficult =3, Less Difficult =2 and Not Difficult =1. Section B was made up of ten items on a 4-point Likert scale of Strongly Agree =4, Agree =3, Disagree = 2 and Strongly Disagree =1.The face and content validity of the instrument was ascertained through a peer review of mathematics educators. The instrument was established reliable with a reliability index of 0.75 using the test-retest method. The data obtained were analyzed using mean. The criterion mean for each item in both sections of DCIQM was 2.5.

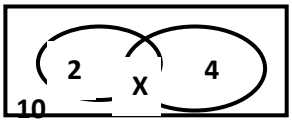
RESULTS AND DISCUSSION

Research Question I: What mathematics concepts do students perceive as difficult in the senior secondary school mathematics curriculum?

Table 1: Students' Perception of Difficult concepts in Mathematics

Rating: VD – 4, D – 3, LD – 2, ND – 1

S/N	Topic	Very difficult	Difficult	Less difficult	Non-difficult	$\overline{X}$	Decision
		N	N	N	N		
1.	Number Base System - Conversion of decimal fraction from other bases to base 10	-	-	240	130	1.48	**Not diff**
	Apply Number Base in Computer Programming	256	153	248	31	2.59	**Diff**
2.	Modular arithmetic Simple or basic operations	-	-	-	-	-	
	Solving Problems in Standard Form	12	36	362	53	1.85	**Not diff**
	Laws of indices and Problems involving indices e.g. $a^x \times a^y = a^{x+y}$ etc.	4	-	428	32	1.86	**Not diff**
3.	Logarithms Indices and logarithms	-	-	-	-	-	
	Graphs of $y = 10^x$	164	156	314	-	2.54	**Diff**

	Use of logarithm tables in calculation i division powers and roots e.g. 214.3 x $3\sqrt{308}$	-	83	416	21	2.08	**NotDiff**
	- solve problems related to capital market (Application of logarithms)	52	42	226	1.0	1.66	**Not Diff**
4.	Set theory Identify types of set	201	93	200	63	2.26.	**Not diff**
	Use of venn diagram	208	102	200	64	2.29	**Not diff**
	Use venn diagram to solve real life problems E.g. Find x? 	208	93	200	63	2.26	**Not diff**
5.	Simple Equations and variations. Problems involving in verse variation	132	27	326	55	2.16	**Not diff**
	Joint variation and	16	33	360	56	1.86	**Not diff**
	Application of variation	16	33	360	56	1.86	**NotDiff**
	Simple equations and variations	-	-	128	158	1.36	**NotDiff**
	Simultaneous Equation	-	-	362	8.69	1.72	**NotDiff**
	Quadratic equation:	-	-	400	50	1.80	**NotDiff**
	Factorization of Quadratic Equation	-	-	242	149	1.56	**NotDiff**
	One linear one quadratic simultaneous equation.	64	96	206	74	1.96	**NotDiff**
	Forming Quadratic equations with known roots	112	3	222	100	1.87	**NotDiff**
	Solve word problems in Quadratic Equation.	116	54	206	100	1.90	**NotDiff**
6.	Construction Bisection of lines and apples	-	-	252	124	1.49	**NotDiff**
	Constructing angles	-	-	264	118	1.53	**NotDiff**
	Construction of equidistance point	-	-	46	217	1.05	**NotDiff**
	Locus of moving points	80	168	218	154	2.48	**NotDiff**
	Proofs of some Basic theorems	480	342	160	41	4.05	**Diff**
7.	Trigonometrical ratio Solve problems involving use of sine and cosine formula.	-	-	367	139	2.02	**NotDiff**
	Ratios of 30, 40 and 60	-	-	384	133	2.06	**NotDiff**
	Solving problems using Trigonometrical Ratios	-	-	416	117	2.13	**NotDiff**
	Drawing graphs of sine and cosine of angles.	480	342	160	41	4.05	**Diff**
8.	Mensuration. Find length of arc practically	428	372	78	40	2.47	**Not Diff**

	Determine perimeter of a circle, segments of circles	76	171	280	109	2.54	**Diff**
	Length of arcs using formula	-	306	226	100	2.53	**Diff**
	Area of a sector	-	-	422	114	2.14	**Not Diff**
	Find area of triangle and subtract area of circle e.g.	-	-	570	80	2.60	**Diff**
	Relationship between surface area of a cone and sector of a circle.	172	168	344	97	3.12	**Diff**
9.	Statistics Construction of frequency distribution curve, histograms, bar chart and line graphs; pie chart	-	-	580	35	2.46	**Not Diff**
	Frequency polygon (O give)	-	-	568	41	2.46	**Not Diff**
10.	Approximations Calculate percentage errors	-	-	216	109	1.31	**Not Diff**
	Degree of accuracy	-	-	300	100	1.60	**Not Diff**
11.	Sequence and series Arithmetic progression	204	132	336	61	2.93	**Diff**
	Geometric progression	92	58	246	71	2.27	**Not Diff**
	Practical problems on AP and G.P	212	114	122	-	1.75	**Not Diff**
12.	Graphical solutions of Quadratic and simultaneous equations	-	300	140	170	2.32	**Not diff**
	Gradient of a curve Drawing tangents to a curve, at a given point.	-	576	208	29	3.25	**Diff**
13.	Inequalities, graphs and problems in inequalities. Linear inequalities in two variables	142	165	344	55	2.82	**Diff**
	Deducing maximum and minimum values of inequality graphs	-	-	560	45	2.42	**Not Diff**
	Introduction to linear programming	232	198	202	100	2.93	**Diff**
14.	Measuration II: Chord and theorems: Angles subtended at the centre, Angles subtended by chords in a circles, Angles in alternate segments.	432	336	-	105	3.45	**Diff**
15.	Circle theorems – Angles at centre is twice that at the circumstance Problems involving circle theorems	504	246	214	-	3.86	**Diff**
16.	Derivation of sine and cosine rule. Bearings – angle of elevation and depression.	616	108	200	60	3.94	**Diff**
	Practical problems on bearings.	720	363	28	10	4.46	**Diff**
17.	Measures of central tendency – mean, median, mode or ungrouped data. Def. of range, variance, standard deviation practical application in capital market reports.	416	363	160	20	3.84	**Diff**
	Areas of applications	480	423	128	-	4.12	**Diff**
18.	The concept of probability Practical example; list chance instruments (dice, coin, park of playing cards)	-	-	328	161	1.96	**Not Diff**
19.	Matrices and Determinants Transpose of determinants	-	189	284	120	2.37	**Not Diff**
	Solving simultaneous equations using determinants	584	249	192	-	4.10	**Diff**

	Addition and multiplication of matrices	408	429	-	80	3.67	**Diff**
20.	Arithmetic of finance Simple and compound interest	-	-	352	102	1.82	**Not Diff**
	Depreciation and rate of depreciation	-	-	360	104	1.86	**Not Diff**
	Amortization	172	474	120	-	3.06	**Diff**
	Problems in capital market using logarithm table	172	474	120	-	3.06	**Diff**
21.	Longitude and latitude Problems on longitude and latitude	40	486	306	-	3.32	**Diff**
	Co-ordinate geometry of straight lines	3	45	276	109	1.72	**Not Diff**
	Distance between points	-	-	292	152	1.78	**Not Diff**
	Gradient and intercept of a straight line.	-	-	-	109	0.44	**Not Diff**

Table 1 indicated that difficulty exists in the Students' assessment of the curriculum for mathematics.

Some concepts, such as the application of Number base System in Computer Programming (2.59> $\bar{x}$ >2.50), drawing of graphs especially of $y = 10^x$ ($\bar{x}$:2.54>2.50), drawing of graphs of sine and cosine of stated angles ($\bar{x}$: $2.50 \geq 2.50$). In the study of geometry, students were faced with difficulties in understanding the concepts of determination of the perimeter of a circle length of arcs, segments of a circle and generally on mensuration ($\bar{x}$:2.53>2.50>2.54). Moreso, problems involving mathematical relationship between surface area of a cone and sector of a circle ($\bar{x}$:3.12>2.50); and arithmetic processes involving estimation to the degree of accuracy.

Furthermore, students find problems involving Arithmetic and Geometric Progression difficult ($\bar{x}$:2.93>2.50) inspite of understanding how to tackle some practical problem involving Arithmetic Progression (A.P) and Geometric Progression (G.P) successfully. The students also had difficulties with the tackling of problems on drawing of tangents and gradient of a curve ($\bar{x}$:3.25>2.50). Introduction to linear programming ($\bar{x}$:2.93>2.50).

Theorems: Proof of theorems involving chord ($\bar{x}$:3.45>2.50) and circle theorems constituted some difficulties for the students. About 201% of the students have difficulties on how to proof that the angles at the centre of a circle, is twice that, which it subtends at circumference of the circle. Problems involving bearing, angle of elevation and depression; derivation of sine and cosine rules, 24% of the respondents assessed this concept as non-difficult which 246% of the respondents accepted that the concepts are very difficult for students to understand. For practical problems on navigation and bearing, ($\bar{x}$:4.46>2.50) more of the students had difficulties in conceptual understanding of the practical aspects of bearing. Students could easily solve problem involving mean, mode and median for ungrouped data but the application of measures of central tendency involving range, variance and standard deviation (SD) constituted a serious difficulty to learners ($\bar{x}$:4.12>2.50). They also had same difficulty in solving simultaneous equations involving determinants, and addition and multiplication of matrices. ($\bar{x}$:3.67>2.50). A lot of students are not familiar with the concepts of Amortization, depreciation and other arithmetic of finance such as problems in capital market using logarithm table ($\bar{x}$:3.06>2.50). Solving problems involving longitude and latitude was assessed as difficult ($\bar{x}$:3.32>2.50).

It means that students reasoning abilities, problem solving process and exposition to concepts in school certificate examination is quite low and if students difficulties in there concepts are not remarked; it could constitutes a poor performance and eventual lack of interest in the subject area at the long run.

Research Question 2: What are the possible causes of the identified difficult concepts in the senior secondary school curriculum as perceived by the students?

Table 2: Causes of the identified difficult concepts in mathematics

S/N	CAUSES OF CONCEPT DIFFICULTY IN MATHEMATICS	SA n (4)	A n (3)	D n (2)	SD n (1)	$\bar{X}$	DECISION
1	Lack of mathematics teachers in the school	25 100	47 141	57 114	121 121	1.9	Disagree
2	Non completion of mathematics scheme of work.	120 480	77 231	30 60	26 26	3.2	Agree
3	Lack of relating mathematics concepts to real life activities.	98 392	84 252	19 38	49 49	2.9	Agree
4	Deliberate skipping of some mathematics concepts by teachers	130 520	74 222	34 68	22 22	3.3	Agree
5	Dominant use of discussion teaching method by teachers	93 372	78 234	79 158	-	3.1	Agree
6	There are some mathematics concepts that do not interest me.	88 352	79 237	50 100	33 33	2.8	Agree
7	Insufficient problem solving in mathematics concepts	162 648	88 264	-	-	3.6	Agree
8	Non marking and correction of assignment to find out students strengths and weaknesses in mathematics concepts.	46 184	42 126	91 182	71 71	2.2	Disagree
9	I do study mathematics after classroom teaching	114 456	57 171	34 68	45 45	3.0	Agree
10	I have the believe that mathematics is difficult	119 476	72 216	39 78	20 20	3.2	Agree

Table 1 showed that students have knowledge of some of the factors that can cause mathematics concepts to be difficult. Students agreed with items 2, 3, 4,5, 6, 7, 9 and 10. The items that students disagreed with were items 1 and 8. The agreement or disagreement was based on the criterion mean of 2.5. From the finding, it is obvious that are mathematics teachers in schools who teach, give assignments to students, mark and correct the assignments. Students put effort on their own to study mathematics after classroom instruction. Despite all these, students still struggle with some mathematics concepts which are termed difficult. Sufficient problem solving and use of researchable teaching strategies should be employed by teachers.

CONCLUSION

This study therefore concludes that there are mathematics concept that are difficult although the difficulty varies from concept to concept as perceived by students and that students are aware of the factors that can attribute to the concept difficulty.

RECOMMENDATIONS

Based on the findings of this study, the researchers recommended the following:

1. Workshops should be organized for mathematics teachers to train them on how to effectively teach the identified difficult mathematics concepts which students struggle with.
2. Mathematics teachers should abstain from concept skipping and endeavour to complete the scheme of work by relating the teaching of mathematics to students' daily activities via sufficient problem solving.

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