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Assessment of Students' Perception of Content Difficulty in the Nigerian Further Mathematics Curriculum

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Abstract:
The study assessed the extent of students' perception of content difficulty in the Nigerian Further Mathematics Curriculum (FMC).The descriptive survey research design was adopted for the study. The study was conducted in Gokana local government area of Rivers State, Nigeria with a population of sixty (60) senior secondary class three students offering Further Mathematics from the twelve (12) public senior secondary schools in the area. Census sampling technique was used to select the sample of 60 students used for the study. The instrument for data collection was the researchers' made and validated Further Mathematics Curriculum Content Difficulty Assessment Questionnaire (FMCCDAQ). The test-retest reliability method and Pearson's Product Moment Correlation (PPMC) statistic were used to obtain 0.73 reliability coefficient for the FMCCDAQ. Six research questions guided the study. Mean, standard deviation and simple percentages were used for data analysis. The study found out that students perceived 88.20% of the Further Mathematics curriculum content difficult to learn with learning difficulties in all the FMC themes of pure mathematics, coordinate geometry, statistics, mechanics and operations research indicating poor FMC implementation. The study among others recommended a holistic review of the Nigerian FMC contents and improved instructional effectiveness through training and re-training of Further Mathematics teachers.

Keywords: *Perception, content, difficulty, further mathematics, curriculum*

1. Introduction

Mathematics education has been given a prime place at the basic and post basic levels of education in Nigeria because of its significant contributory role in the social, economic, scientific and technological development of the nation. The national policy on education specified the compulsory teaching and learning of Mathematics at the basic and post basic education levels (Federal Republic of Nigeria (FRN), 2014). The educational policy provided for students to offer the compulsory cross-cutting General Mathematics and the optional Further Mathematics recommended for students with high ability in General Mathematics who require a good foundation for future studies in Mathematics or Mathematics related courses at the senior secondary education level (FRN, 2014; Nigerian Educational Research and Development Council (NERDC), 2012).

The Further Mathematics Curriculum (FMC) was first designed in 1985 by the Federal Ministry of Education with three broad themes of Pure Mathematics, Mechanics and Statistics and three objectives (NERDC, 2012). The objectives of the FMC according to the NERDC (2012) are to: helpthe students to develop conceptual and manipulative skills in Mathematics so as to prepare them for further studies in Mathematics and its application; reflect continuity with those used in Universities, Polytechnics, Federal Colleges of Education and Colleges of Science and Technology, so that graduates of the curriculum have nothing to unlearn on entering any of the above mentioned institutions; prepare potential Mathematicians, Engineers and Scientists. The FMC was reviewed in 2007 by the Nigerian Educational Research and Development Council with the addition of Coordinate Geometry and Operations Research to the previous themes but retaining the same objectives. The five themes of the FMC are Pure Mathematics, Mechanics, Statistics, Coordinate Geometry and Operations Research. This curriculum review was necessitated by the nation's need to develop a new trade-based Mathematics curriculum designed to meet the targets of the National Economic Empowerment and Development Strategy (NEEDS) which emphasised value re-orientation, poverty eradication, job creation, wealth generation and citizenry empowerment through the instrument of education (NERDC, 2012).The implementation of this trade curriculum commenced in the year 2011(NERDC, 2012).

All school subjects have curriculum that guides its classroom content delivery and Further Mathematics is not an exemption. Further Mathematics curriculum is defined as the formal document which prescribes the content of advance mathematical concepts that the teacher is expected to implement in the classroom alongside with performance objectives,

teacher and student activities, the instructional strategies and materials. The curriculum content of Further Mathematics can simply be referred to as advance Mathematics. The above definition implies that Further Mathematics can also be defined as higher Mathematics. This may suggest why some countries call it higher or advanced Mathematics. It also describes a course studied in addition to the General Mathematics. The study of Further Mathematics involves studying both pure and applied Mathematics. The pure part of Further Mathematics is of a higher standard than those of the General Mathematics. The topics covered in Further Mathematics are more sophisticated and conceptually advanced compared to the General Mathematics. Further Mathematics affords Senior Secondary School students' opportunity to be introduced to some topics in Advanced Level mathematics in order to prepare them to study mathematics or mathematics related courses in their next level of education (Charles-Ogan and George, 2019).

Further Mathematics is a highly respected subject and is recognized for its challenging content. It is recommended for students with high ability in General Mathematics who will need to acquire a foundation for future studies in Mathematics or the Mathematics related sciences. Despite the fact that the subject is recommended for high ability students, it does not rule out the fact that students who offer it are free of difficulties that may arise from its learning. To this end Iji and Omenka (2015) opined that some of the reasons that make students experience difficulties in Nigerian Mathematics programmes are non-preparedness of Mathematics teachers to handle the teaching of the curriculum contents, insufficient time to teach and overload of the curriculum. It is over a decade since the trade-based Mathematics curriculum was designed and implemented. With the introduction of new and advance curriculum contents in the FMC, the researchers deemed it fit to embark on this study, so as to ascertain the students' perception of content difficulty in the Nigerian Further Mathematics Curriculum.

1.1. Statement of the Problem

Research reports revealed abysmal performance of senior secondary students in General Mathematics in external examinations with students perceiving some contents of the General Mathematics Curriculum (GMC) difficult to learn (Zalmon & Wonu, 2017; Zalmon & George, 2018). If the same students offering General Mathematics and Further Mathematics had perceived learning difficulties in the GMC content which is a prerequisite to learning the FMC content, it is expected that their perception of content difficulty in the FMC will be higher with a corresponding poor performance in external examinations. Therefore, the investigation delved into finding answer to the question: what is the extent of students' perception of content difficulty in the Nigerian Further Mathematics curriculum?

1.2. Aim and Objectives of the Study

The aim of this study was to assess the extent of students' perception of content difficulty in the Nigerian Further Mathematics Curriculum (FMC).The objectives were to:

- Assess the extent of students' perception of the Pure Mathematics content difficulty in the FMC.
- Determine the extent of students' perception of the Coordinate Geometry content difficulty in the FMC.
- Ascertain the extent of students' perception of the Statistics content difficulty in the FMC.
- Find out the extent of students' perception of the Mechanics content difficulty in the FMC.
- Evaluate the extent of students' perception of the Operations Research content difficulty in the FMC.
- Assess the extent of student perception of the FMC content difficulty.

1.3. Research Questions

Six research questions guided the study:

- What is the extent of students' perception of the Pure Mathematics content difficulty in the FMC?
- What is the extent of students' perception of the Coordinate Geometry content difficulty in the FMC?
- What is the extent of students' perception of the Statistics content difficulty in the FMC?
- What is the extent of students' perception of the Mechanics content difficulty in the FMC?
- What is the extent of students' perception of the Operations Research content difficulty in the FMC?
- What is the extent of students' perception of the FMC content difficulty?

2. Methodology

The descriptive survey research design was adopted for the study. The study was conducted in Gokana local government area of Rivers State, Nigeria with a population of sixty (60) senior secondary class three students offering Further Mathematics from the twelve (12) public senior secondary schools in the area. The senior secondary class three students constituted the population of the study because the study was interested in assessing the perception of difficulty of students who had been taught most of the Further Mathematics curriculum contents. Further Mathematics is optional and few schools and students offer the subject. Census sampling technique was used to select all the 60 students in the population of the study used for the study as sample. The census sampling technique was deemed fit for this study because the elements of the population was small for selection to be carried out. The instrument for data collection was the researchers' made Further Mathematics Curriculum Content Difficulty Assessment Questionnaire (FMCCDAQ). The FMCCDAQ consisted of 263FMC contents patterned after the four-point Likert rating scale of Very Difficult (VD) – 4 points, Difficult (D) – 3 points, Easy (E) – 2 points and Very Easy (VE) – 1 point with a criterion mean of 2.50.The decision rule was: Difficult content (mean≥ 2.50); Easy content (mean< 2.50). The FMCCDAQ had two sections. Section A and section B. Section A was used to elicit demographic information such as class and gender from the respondents while section B was used to obtain the response of the respondents on their perception of the Further Mathematics curriculum content

difficulty based on the five themes of the curriculum namely; Pure Mathematics, Coordinate Geometry, Statistics, Mechanics and Operations Research. Three experts in Curriculum Studies and Mathematics Education validated the instrument face and content wise. The test-retest reliability method and Pearson's Product Moment Correlation (PPMC) statistic were used to obtain 0.73 reliability coefficient for FMCCDAQ. The FMCCDAQ was administered to the participants on a face to face mode by the researchers with the assistant of theFurther Mathematics teachers. Mean, standard deviation and simple percentages were the statistical tools used for data analysis. The decisionrule was: Difficult content (mean≥ 2.50); Easy content (mean< 2.50).

3. Results

- Research question one: What is the extent of students' perception of the Pure Mathematics content difficulty in the FMC?

S/N	Pure Mathematics Contents	VD	D	E	VE	Mean	SD	Decision
	Definition of sets	0	6	23	31	1.58	0.67	E
	Set notation methods	14	13	15	18	2.38	1.15	E
	Null set	16	15	13	16	2.52	1.16	D
	Singleton set	12	20	11	17	2.45	1.11	E
	Finite and infinite set	2	14	25	19	1.98	0.83	E
	Subsets	5	11	14	30	1.85	1.01	E
	Universal set	0	8	14	38	1.50	0.72	E
	Power set	3	10	28	19	1.95	0.83	E
	Union of sets	0	11	20	29	1.70	0.77	E
	Intersection of set	2	2	27	29	1.62	0.72	E
	Complements of set	5	2	35	18	1.90	0.82	E
	Number of elements in a set	7	14	22	17	2.18	0.98	E
	Venn diagram and applications up to 3 set problem	10	16	19	15	2.35	1.04	E
	Definition of binary operation	8	9	23	20	2.08	1.01	E
	Association law of binary operation	13	21	13	13	2.57	1.06	D
	Commutative law of binary operation	13	17	16	14	2.48	1.08	E
	Distributive law of binary operation	19	11	17	13	2.60	1.15	D
	Laws of complementation as insets	22	18	15	5	2.95	0.98	D
	Identify elements	14	22	19	5	2.75	0.91	D
	Inverse of an element	22	19	17	2	3.02	0.89	D
	Multiplication tables of binary operation	17	6	26	11	2.48	1.10	E
	Definition of indices	9	5	23	23	2.00	1.04	E
	Multiplicative laws of indices	9	3	30	18	2.05	0.98	E
	Divisional law of indices	14	2	31	13	2.28	1.06	E
	Power law of indices	14	4	25	17	2.25	1.11	E
	Zero power law of indices	9	13	19	19	2.20	1.05	E
	Negative power law of indices	13	13	15	19	2.33	1.14	E
	Inverse power law of indices	8	23	14	15	2.40	1.01	E
	Applications of indices, solution of indicial equations up to quadratic equation	28	13	7	12	2.95	1.19	D
	Logarithms	2	2	36	20	1.77	0.67	E
	Definition of logarithm	2	1	34	23	1.70	0.67	E
	Multiplicative laws of logarithm	2	16	32	10	2.17	0.74	E
	Divisional law of logarithm	9	10	33	8	2.33	0.90	E
	Power law of logarithm	7	19	23	11	2.37	0.92	E
	Logarithm of number in the same base	13	15	23	9	2.53	1.00	D
	Logarithm of number equal to 1	14	24	19	3	2.82	0.85	D
	Logarithm of a number equal to zero	12	28	15	5	2.78	0.87	D
	Change of base of logarithm	16	10	24	10	2.53	1.07	D
	Definition of surds	10	10	32	8	2.37	0.92	E
	Rules for manipulating surds ($\sqrt{ab}$)	23	21	12	4	3.05	0.93	D
	Multiplicative rule of surds ($\sqrt{ab}$)	25	12	21	2	3.00	0.96	D
	Divisional rule of surds ($\sqrt{ab}$)	29	13	16	2	3.15	0.94	D
	Power rule of surds ($\sqrt{ab}$)	20	14	23	3	2.85	0.95	D

S/N	Pure Mathematics Contents	VD	D	E	VE	Mean	SD	Decision
	Inverse power rule of surd	31	17	7	5	3.23	0.96	D
	Rationalization of the denominator	34	12	9	5	3.25	1.00	D
	Definition of function	32	14	9	5	3.22	0.99	D
	One to one function	26	16	11	7	3.02	1.05	D
	Onto function	27	21	6	6	3.15	0.97	D
	Inverse function	24	25	4	7	3.10	0.97	D
	Identify function	26	22	8	4	3.17	0.91	D
	Constant function	26	13	15	6	2.98	1.05	D
	Circular function	26	19	11	4	3.12	0.94	D
	Logarithmic function	12	24	17	7	2.68	0.93	D
	Experiential function	20	15	18	7	2.80	1.04	D
	Composite function	26	21	8	5	3.13	0.95	D
	Application of functions	26	22	5	7	3.12	0.99	D
	Solutions of problems of function	26	20	9	5	3.12	0.96	D
	Definition of sequence	12	15	20	13	2.43	1.05	E
	The nth them of a sequence	10	9	20	21	2.13	1.08	E
	Definition of series	16	6	25	13	2.42	1.11	E
	The nth term of a series	13	10	19	18	2.30	1.12	E
	Arithmetic and geometric progressive	18	11	13	18	2.48	1.21	E
	Linear inequalities in one variable	21	10	16	13	2.65	1.18	D
	Linear inequalities in two variables	24	8	17	11	2.75	1.17	D
	Graphs of linear inequalities in two variables	28	12	17	3	3.08	0.98	D
	Quadratic inequalities	15	26	18	1	2.92	0.79	D
	Inequalities in two dimensions	25	20	14	1	3.15	0.84	D
	Calculating devices	26	22	11	1	3.22	0.80	D
	Abacus calculating devices	20	21	11	8	2.88	1.03	D
	Decimal system	5	22	26	7	2.42	0.81	E
	Binary system	16	1	38	5	2.47	0.98	E
	Flow charts	33	10	14	3	3.22	0.98	D
	Application of flow charts	31	11	15	3	3.17	0.98	D
	Trigonometric ratios of 30^0, 45^0,60^0	31	11	15	3	3.17	0.98	D
	Application of trigonometric ratio of 30^0, 45^0, 60^0	38	11	8	3	3.40	0.91	D
	Six trigonometric functions of angles of any magnitude (sine, cosine, tangent secant cosecant cotangent)	33	8	15	4	3.17	1.03	D
	Range or specified trigonometry	30	19	10	1	3.30	0.81	D
	Domain of specified trigonometry	30	12	17	1	3.18	0.91	D
	Graphs of trigonometric ratios with emphasis on their amplitude and periodicity	30	18	9	3	3.25	0.89	D
	Relationship between graphs of trigonometric ratios (y= a sin (bx) +c, y=a cos (bx) + c, y=a+ tan (bx) +c	37	11	11	1	3.40	0.85	D
	Graphs of inverse by ratios	33	11	15	1	3.27	0.90	D
	Solutions of simple equation involving the six trigonometric function	25	18	9	8	3.00	1.06	D
	Proofs of simple trigonometric identities ($\sin^2x + \cos^2x=1$, $\sec^2x = 1+ \tan^2 x$	28	18	4	10	3.07	1.10	D
	Sum of roots of quadratic equation ($\alpha+\beta=^{-b}/_{a}$)	17	19	14	10	2.72	1.06	D
	Product of roots of quadratic equation ($\alpha\ \beta=$ $^{c}/_{a}$)	11	16	27	6	2.53	0.91	D
	Finding quadratic equation given sum and products of roots (x^2- (sum of roots) + product) = 0	14	16	24	6	2.63	0.96	D
	Condition for quadratic equation to have equal roots ($b^2 =4ac$)	31	12	11	6	3.13	1.05	D
	Condition for quadratic equation to have real roots ($b^2>4ac$)	35	6	14	5	3.18	1.07	D

S/N	Pure Mathematics Contents	VD	D	E	VE	Mean	SD	Decision
	Condition for quadratic equation to have no roots ($b^2 < 4ac$)	27	12	16	5	3.02	1.03	D
	Condition for given line to intersect a curve	24	15	14	7	2.93	1.06	D
	Condition for given line to be tangent to curve	18	24	12	6	2.90	0.95	D
	Condition for given line not to intersect a curve	20	17	17	6	2.85	1.01	D
	Solution of problems on roots quadratic equation	25	9	20	6	2.88	1.08	D
	Definition of polynomials	24	6	22	8	2.77	1.13	D
	Division of polynomials by a polynomial of lesser degree	32	13	8	7	3.17	1.06	D
	Remainder theorem	33	8	15	4	3.17	1.03	D
	Factorization of polynomial	25	16	9	10	2.93	1.12	D
	Roots of cubic equation	30	10	17	3	3.12	0.99	D
	Sum of roots	17	18	22	3	2.82	0.91	D
	Product of roots	14	18	25	3	2.72	0.88	D
	Sum of products of two roots	19	16	22	3	2.85	0.94	D
	Logical reasoning	20	24	10	6	2.97	0.96	D
	Definition of statement	18	19	13	10	2.75	1.07	D
	Negation of statement	15	27	11	7	2.83	0.94	D
	Contra-positive of statement	19	23	9	9	2.87	1.03	D
	Antecedents and consequence of statement	30	9	16	5	3.07	1.06	D
	Conditional statement	29	8	15	8	2.97	1.13	D
	Fundamental issues in intelligent system	32	12	13	3	3.22	0.96	D
	Fundamental definition	30	11	15	4	3.12	1.01	D
	Modeling the world	35	1	20	4	3.12	1.09	D
	Introduction to propositional and predicate logical resolution	41	6	10	3	3.42	0.94	D
	Introduction to theorem proving	37	8	9	6	3.27	1.06	D
	Pascal triangle	37	6	10	7	3.22	1.11	D
	Binomial expansion of $(a+b)^n$ where n is the positive integer	30	13	14	3	3.17	0.96	D
	Binomial expansion of $(a+b)^{-n}$ where n is the negative integer	28	16	11	5	3.12	0.99	D
	Binomial expansion of $(a+b)^{1/n}$ where 1/n is the fractional value	30	22	5	3	3.32	0.83	D
	Finding the nth term	24	7	26	3	2.87	1.02	D
	Application of binomial expansion	31	9	19	1	3.17	0.94	D
	Limits of a function	36	7	13	4	3.25	1.02	D
	Differentiation of polynomial	37	6	16	1	3.32	0.93	D
	Differentiation of transcendental functions such as sin x, e^{ax}, log 3x	32	15	10	3	3.27	0.92	D
	Product rule of differentiation	33	11	13	3	3.23	0.96	D
	Quotient rule of differentiation	26	14	15	5	3.02	1.02	D
	Function of function (chain rule)	23	17	14	6	2.95	1.02	D
	Application of differentiation to rate of change	29	18	5	8	3.13	1.05	D
	Application of differentiation to gradient	26	16	12	6	3.03	1.02	D
	Application of differentiation to maximum and minimum values	28	15	12	5	3.10	1.00	D
	Application of differentiation to equation of motion	26	20	9	5	3.12	0.96	D
	Higher derivative	33	14	8	5	3.25	0.99	D
	Differentiation implicit function	38	12	7	3	3.42	0.89	D
	Matrices as linear transformations	36	14	7	3	3.38	0.88	D
	Determinants	35	12	10	3	3.32	0.93	D
	Solutions of 2 and 3 simultaneous equations	20	10	27	3	2.78	0.98	D
	Proper rational functions with denominators as linear factors (distinct and repeated) and others	33	13	11	3	3.27	0.94	D

S/N	Pure Mathematics Contents	VD	D	E	VE	Mean	SD	Decision
	Understand integration as the reverse process of differentiation	38	14	4	4	3.43	0.89	D
	Integration of algebraic polynomials including 1/x, logarithmic functions	34	18	5	3	3.38	0.85	D
	Definite integrals and application to kinematics apply to v-t and s-t graphs	38	13	8	1	3.47	0.79	D
	Areas under the curve	30	13	13	4	3.15	0.99	D
	Trapezoidal rule	31	13	11	5	3.17	1.01	D
	Volume of solids of revolution	29	17	10	4	3.18	0.95	D
	Grand Mean					2.82	0.98	D

Table 1: Meanand Standard Deviation on the Extent of Students' Perception of the Pure Mathematics Content Difficulty in the FMC
Difficult (D); Easy (E), D=75%; E=25%

Data in table 1 revealed that students perceived the Pure Mathematics contents of the FMC difficult to learn (Mean=2.82; SD=0.98). Table 1 also showed that the extent of students' perception of the Pure Mathematics content difficulty in the FMC was high (75%).

- Research question two: What is the extent of students' perception of the Coordinate Geometry content difficulty in the FMC?

S/N	Coordinate Geometry Contents	VD	D	E	VE	Mean	SD	Decision
1.	Gradient of a straight line	30	10	12	8	3.03	1.12	D
2.	Distance between two points	25	8	20	7	2.85	1.10	D
3.	Condition for parallelism	31	11	13	5	3.13	1.03	D
4.	Condition for perpendicularity	24	20	12	4	3.07	0.94	D
5.	Equation of a line	26	15	15	4	3.05	0.98	D
6.	Transform relationship into linear form	24	17	12	7	2.97	1.04	D
7.	Areas of triangles and quadrilateral	24	24	8	4	3.13	0.89	D
8.	Definition of circle	19	8	26	7	2.65	1.05	D
9.	Equation of circle given center and radius	23	12	21	4	2.90	1.00	D
10.	General equation of a circle	26	12	16	6	2.97	1.06	D
11.	Finding center and radius of a given circle	25	11	15	9	2.87	1.13	D
12.	Finding equation of a circle given the end point of the diameter	29	13	12	6	3.08	1.05	D
13.	Equation of circle passing through 3 points	42	6	6	6	3.40	1.03	D
14.	Equation of tangent to a circle	28	17	9	6	3.12	1.01	D
15.	Length of tangent to a circle	30	21	6	3	3.30	0.85	D
16.	Equation of parabola in rectangular Cartesian coordinate	25	27	5	3	3.23	0.81	D
17.	Equation of ellipse in rectangular Cartesian coordinate	25	28	4	3	3.25	0.79	D
18.	Parametric equation	33	19	5	3	3.37	0.84	D
	Grand Mean					3.08	0.99	D

Table 2: Mean And Standard Deviation (SD) On the Extent of Students' Perception of the Coordinate Geometry Content Difficulty in the FMC
Difficult (D); Easy (E), D=100%; E=0%

Data in table 2 revealed that students perceived the Coordinate Geometry content of the FMC difficult to learn (Mean=3.08; SD=0.99). Table 2 also showed that the extent of student perception of the Coordinate Geometry content difficulty in the FMC was high (100%).

- Research question three: What is the extent of students' perception of the Statistics content difficulty in the FMC?

S/N	Statistics Contents	VD	D	E	VE	Mean	SD	Decision
1.	Mean	10	11	24	15	2.27	1.02	E
2.	Mode	8	7	29	16	2.12	0.96	E
3.	Median	9	15	22	14	2.32	1.00	E
4.	Deciles	18	20	11	11	2.75	1.08	D
5.	Percentile	19	20	9	12	2.77	1.11	D
6.	Quartiles	13	18	17	12	2.53	1.05	D
7.	Range	5	19	23	13	2.27	0.90	D
8.	Inter-quartiles	18	23	14	5	2.90	0.93	D
9.	Mean deviation	11	17	19	13	2.43	1.03	E
10.	Standard deviation	11	12	30	7	2.45	0.93	E
11.	Coefficient of variation	14	15	21	10	2.55	1.03	D
12.	Classical	35	14	8	3	3.35	0.90	D
13.	Frequential	32	15	9	4	3.25	0.95	D
14.	Axiomative approaches to probability	33	17	6	4	3.32	0.91	D
15.	Sample space	37	9	11	3	3.33	0.95	D
16.	Event space	30	12	15	3	3.15	0.97	D
17.	Mutually exclusive event	37	8	12	3	3.32	0.97	D
18.	Independent event	32	13	10	5	3.20	1.01	D
19.	Conditional event	39	8	10	3	3.38	0.94	D
20.	Conditional probability	33	6	14	7	3.08	1.12	D
21.	Probability trees	30	8	14	8	3.00	1.13	D
22.	Permutation on arrangement	25	14	10	11	2.88	1.15	D
23.	Cyclic permutation	31	6	16	7	3.02	1.13	D
24.	Arrangement of identical objects	27	15	8	10	2.98	1.13	D
25.	Arrangement in which repetitions are allowed	33	10	6	11	3.08	1.18	D
26.	Introduction to combination on selection	30	19	5	6	3.22	0.98	D
27.	Conditional arrangements and selection	26	21	7	6	3.12	0.98	D
28.	Probability arrangement problem involving arrangement and selection	28	14	12	6	3.07	1.04	D
29.	Variance	32	10	17	1	3.22	0.92	D
30.	Coefficient of variance of binomial distributions	35	9	13	3	3.27	0.97	D
31.	Coefficient of variance of Poisson distribution	36	6	15	3	3.25	1.00	D
32.	Coefficient of variance of normal distributions	35	7	15	3	3.23	1.00	D
33.	Binomial distribution	25	18	16	1	3.12	0.87	D
34.	Poisson distribution	28	16	15	1	3.18	0.87	D
35.	Normal distribution	32	17	10	1	3.33	0.82	D
36.	Binomial approximations by Poisson distributions	33	13	13	1	3.30	0.87	D
37.	Normal approximations by binomial distributions	32	13	12	3	3.23	0.95	D
38.	Concept of correlations as measure of relationship	29	11	17	3	3.10	0.99	D
39.	Scatter diagrams	32	12	11	5	3.18	1.02	D
40.	Rank correlation	29	11	14	6	3.05	1.06	D
41.	Tied ranks	32	18	7	3	3.32	0.87	D
42.	Classical	27	10	17	6	2.97	1.07	D
	Grand Mean					3.00	0.99	D

Table 3: Mean and Standard Deviation (SD) on the Extent of Students' Perception of the Statistics Content Difficulty in the FMC
Difficult (D); Easy (E), D=88%; E=12%

Data in table 3 showed that students perceived the Statistics contents of the FMC difficult to learn (Mean=3.00; SD=0.99). Table 3 also revealed that the extent of students' perception of the Statistics content difficulty in the FMC was high (88%).

- Research question four: What is the extent of students' perception of the Mechanics content difficulty in the FMC?

S/N	Mechanics Contents	VD	D	E	VE	Mean	SD	Decision
1.	Scalars quantity	19	14	18	9	2.72	1.08	D
2.	Vectors quantity	17	11	19	13	2.53	1.13	D
3.	Zero vector	14	17	18	11	2.57	1.05	D
4.	Negative vector	12	10	23	15	2.32	1.07	E
5.	Vectors	10	11	27	12	2.32	0.98	E
6.	Vector addition and subtraction	17	5	26	12	2.45	1.11	E
7.	Scalar multiplication of vectors	14	9	18	19	2.30	1.15	E
8.	Magnitude and direction of a vector	21	11	20	8	2.75	1.08	D
9.	Unit vector	17	14	22	7	2.68	1.02	D
10.	The triangle law	25	9	15	11	2.80	1.18	D
11.	The parallelogram law	22	5	19	14	2.58	1.21	D
12.	Resolution of vectors	22	8	18	12	2.67	1.17	D
13.	Scalar (dot) product	24	7	22	7	2.80	1.10	D
14.	Application of scalar (dot) product	30	10	13	7	3.05	1.10	D
15.	Scalar product of vectors in three dimensions	28	6	19	7	2.92	1.12	D
16.	Application of scalar product	28	12	13	7	3.02	1.08	D
17.	Vector or cross product in three dimensions	30	7	19	4	3.05	1.05	D
18.	Application of cross product	36	11	9	4	3.32	0.97	D
19.	Newton's law of motion	27	6	15	12	2.80	1.22	D
20.	Motion along inclined plane	35	1	13	11	3.00	1.25	D
21.	Motion of connected particles	30	7	15	8	2.98	1.14	D
22.	Work	14	9	29	8	2.48	1.00	E
23.	Power	10	5	37	8	2.28	0.90	E
24.	Energy	13	11	23	13	2.40	1.06	E
25.	Impulse and momentum	25	7	16	12	2.75	1.20	D
26.	Projectiles	25	7	13	15	2.70	1.25	D
27.	Trajectory of projectiles	30	11	6	13	2.97	1.22	D
28.	Greatest height reached	30	8	10	12	2.93	1.22	D
29.	Time of flight	27	11	10	12	2.88	1.19	D
30.	Range	15	9	22	14	2.42	1.11	E
31.	Projection along inclined plane	33	7	12	8	3.08	1.14	D
32.	Forces in equilibrium	33	7	13	7	3.10	1.12	D
33.	Resultant of parallel forces (in the same direction and in opposite directions) acting on a rigid body	33	9	11	7	3.13	1.10	D
34.	Moment of a force (2 and 3 force) acting at a point	28	8	18	6	2.97	1.09	D
35.	Polygon of forces	31	10	15	4	3.13	1.02	D
36.	Resolution of forces of friction	22	10	22	6	2.80	1.05	D
37.	Application of scalar (dot) product	31	3	21	5	3.00	1.10	D
	Grand Mean					2.77	1.11	D

Table 4: Mean and Standard Deviation (SD) on the Extent of Students' Perception of the Mechanics Content Difficulty in the FMC
Difficult (D); Easy (E), D=78%; E=22%

Data in table 4 showed that students perceived the Mechanics content of the FMC difficult to learn (Mean=2.77; SD=1.11). Table 4 also revealed that the extent of students' perception of the Mechanics content difficulty in the FMC was high (78%).

- Research question five: What is the extent of students' perception of the Operations Research content difficulty in the FMC?

S/N	Operations Research Contents	VD	D	E	VE	Mean	SD	Decision
1.	Definition of operations research	36	6	13	5	3.22	1.06	D
2.	History and nature operation research	34	11	11	4	3.25	0.99	D
3.	Models of operation research	28	12	17	3	3.08	0.98	D
4.	Linear programming model	38	8	11	3	3.35	0.95	D
5.	Transportation model	43	7	7	3	3.50	0.89	D
6.	Assignment models	44	6	7	3	3.52	0.89	D
7.	Practical application of the models	40	13	3	4	3.48	0.87	D
8.	Concept of inventory	42	7	7	4	3.45	0.95	D
9.	Definition of important terms in inventory	42	6	7	5	3.42	1.00	D
10.	Holding list	35	4	14	7	3.12	1.14	D
11.	Demand	26	19	10	5	3.10	0.97	D
12.	Ordering list	37	6	12	5	3.25	1.05	D
13.	Computation of optimal quantity (EOQ model)	40	8	9	3	3.42	0.93	D
14.	Concept of replacement	34	13	10	3	3.30	0.93	D
15.	Individual replacement sudden failure item	45	4	8	3	3.52	0.91	D
16.	Replacement of items that wear out gradually	37	9	10	4	3.32	0.98	D
17.	Introduction of modeling	44	4	8	4	3.47	0.96	D
18.	Dependent and independent variables in mathematical modeling	39	10	6	5	3.38	0.98	D
19.	Examples of some models	33	8	11	8	3.10	1.13	D
20.	Construction of model	31	13	8	8	3.12	1.09	D
21.	Methodology of modeling	38	10	4	8	3.30	1.08	D
22.	Application to physical, biological, social and behavioural services.	31	11	7	11	3.03	1.18	D
23.	Introduction to game theory.	32	10	7	11	3.05	1.19	D
24.	Description of types of games.	31	13	7	9	3.10	1.12	D
25.	Solution of two persons zero sum games using pure and mixed strategies.	34	8	7	11	3.08	1.20	D
26.	Matrix games.	32	11	6	11	3.07	1.18	D
	Grand Mean					3.27	1.02	D

Table 5: Mean and Standard Deviation (SD) on the Extent of Students' Perception of the Operations Research Content Difficulty in the FMC
Difficult (D); Easy (E), D=100%; E=0%

Data in table 5 showed that students perceived the Operations Research content of the FMC difficult to learn (Mean=3.27; SD=1.02). Table 5 also revealed that the extent of students' perception of the operations research content difficulty in the FMC was high (100%).

- Research question six: What is the extent of students' perception of the FMC Themes difficulty?

S/N	FMC Themes	No of Contents	Mean	SD	Difficult (%)	Easy (%)
1	Pure Mathematics	140	2.82	0.98	105(75%)	35(25%)
2	Coordinate Geometry	18	3.08	0.99	18(100%)	0(0%)
3	Statistics	42	3.00	0.99	37(88%)	5(12%)
4	Mechanics	37	2.77	1.11	29(78%)	8(22%)
5	Operations Research	26	3.27	1.02	26(100%)	0(0%)
Total	263	2.99	1.02	215(88.20%)		48(11.80%)

Table 6: Mean, Standard Deviation (SD) and Simple Percentage on the Extent of Students' Perception of the FMC Content Difficulty

Data in table 6 showed that students perceived the Further Mathematics curriculum themes difficult to learn (Mean=2.99; SD=1.02). Table 6 also revealed that the extent of students' perception of the Further Mathematics curriculum themes difficulty was high (88.20%).

4. Discussion of Findings

4.1. Assessment of the Extent of Student Perception of the Pure Mathematics Content Difficulty in the FMC

Data in table 1 revealed that students perceived the pure mathematics content of the FMC difficult to learn (M=2.82; SD=0.98). Table 1 also showed that the extent of student perception of the pure mathematics content difficulty in the FMC was high (75%). An analysis of topics perceived difficult by Nigerian students and teachers in secondary school

Further Mathematics curriculum by Ifamuyiwa (2014) revealed that some topics in pure mathematics such as differential (differentiation) and integral (integration) calculus were difficult with students to learn.

4.2. Determination of the Extent of Student Perception of the Coordinate Geometry Content Difficulty in the Fmc

Data in table 2 revealed that students perceived the coordinate geometry content of the FMC difficult to learn (M=3.08; SD=0.99). Table 2 also showed that the extent of student perception of the coordinate geometry content difficulty in the FMC was high (100%). Wonu and Zalmon (2017) diagnosed coordinate geometry as one of students 'common learning difficulties in geometry. Zalmon and George (2018) reported that students perceived geometry and introductory calculus themes difficult to learn. Further study by Iji and Omenka (2015) identifiedthe contents in the coordinate geometry theme that students perceived difficult to learn as equation of parabola in rectangular Cartesian coordinate and equation of ellipse in rectangular Cartesian coordinate.

4.3. Ascertainment of the Extent of Student Perception of the Statistics Content Difficulty in the FMC

Data in table 3 showed that students perceived the statistics content of the FMC difficult to learn (M=3.00; SD=0.99). Table 3 also revealed that the extent of student perception of the statistics content difficulty in the FMC was high (88%). Wonu and Zalmon (2017) noted earlier that students have difficulties in learning to use the histogram to estimate the mode, differentiate between bar chart and histogram, estimate quartiles and percentiles, using ogive, calculating standard deviation and representing information in a diagram.

4.4. The Extent of Student Perception of the Mechanics Content Difficulty in the FMC

Data in table 4 showed that students perceived the mechanics content of the FMC difficult to learn (M=2.77; SD=1.11). Table 4 also revealed that the extent of student perception of the mechanics content difficulty in the FMC was high (78%).Iji and Omenka (2015) identified the contents in the mechanics theme that students perceived difficult to learn as motion of connected particles, polygon of forces, trajectory of projectile and moment of force (2 and 3 force) acting at a point.

4.5. Students' Perception of the Operations Research Content Difficulty in the FMC

Data in table 5 showed that students perceived the operations research content of the FMC difficult to learn (M=3.27; SD=1.02). Table 5 also revealed that the extent of student perception of the operations research content difficulty in the FMC was high (100%). An analysis of topics perceived difficult by Nigerian students and teachers in secondary school Further Mathematics curriculum by Ifamuyiwa (2014) also revealed that the operations research theme was difficult with students to learn. Iji and Omenka (2015) revealed that the perceived learning difficulty in operations research was due to lack of adequate instructional materials.

4.6. Assessing the Extent of Student Perception of the FMC Content Difficulty

Data in table 6 showed that students perceived the Further Mathematics curriculum content difficult to learn (M=2.99; SD=1.02). Table 6 also revealed that the extent of student perception of the Further Mathematics curriculum content difficulty was high (88.20%). Earlier study by Mills (2011) revealed that more than 30% of students in schools today have significant difficulties in learning Further Mathematics in spite of normal intelligence. Mills (2011) attributed this learning difficulty mainly to students' inadequate preparation and ineffective early education in the underlying basic mathematical operations that are required for Mathematics studies at their current level. Iji and Omenka (2015) identified the Further Mathematics contents perceived difficult with students as coordinate geometry, mechanics and operations research.

5. Conclusion

The study concluded that students' perception of content difficulty in the Further Mathematics curriculum was high(88.20%) and that the difficulty was in all the FMC themes of Pure Mathematics (75%), Coordinate Geometry (100%), Statistics (88%), Mechanics (78%) and Operations Research (100%).

6. Recommendations

Based on the findings the study recommended as follows:

- The Nigerian Educational Research and Development Council (NERDC) should carry out a holistic review of the Further Mathematics curriculum in view of students' high perception of its content difficulty.
- Public school proprietors and educational administrators should ensure instructional effectiveness through adequate provision of learning resources including qualified Further Mathematics teachers and training and re-training of in-service Further Mathematics teachers through sponsorship to attend workshops, seminars, symposia and conferences.
- Students should be encouraged to develop positive attitudes towards learning Further Mathematics through diligence and improved study habit.

7. References

i. Charles-Ogan, G.I. & George, N.R. (2019). Further mathematics content coverage and first year students' algebra and calculus performance in universities in Rivers State Nigeria. *American Journal of Mathematics and Statistics*, 9(3), 115-122.

ii. Federal Republic of Nigeria (2014). *National policy on education (4th ed.).* Lagos: Nigerian Educational Research and Development Council (NERC) Press.
iii. Ifamuyiwa, A.S. (2014). Analysis of topics perceived difficult by Nigerian students and teachers in secondary school further mathematics. *Abacus: Journal of Mathematical Association of Nigeria, 39(1),* 255-268.
iv. Iji, C. O. & Omenka, J. E. (2015). Mathematics teachers' perception of difficult concepts in secondary school Mathematics curriculum in Benue State, Nigeria. *Asia Pacific Journal of Education, Arts and Sciences, 2(1),* 32 – 45.
v. Mills, D. (2011). Mathematics learning difficulties. Retrieved May 15, 2019 from http://www.mathlearningdifficulties.com
vi. Wonu N. & Zalmon I.G. (2017). Diagnosis and remediation of senior secondary student common learning difficulties in Mathematics from chief examiners' report. *European Journal of Research and Reflection in Educational Sciences,5(1),* 256-282.
vii. Zalmon, I.G. & George, N.R. (2018). Student and teacher perception of content difficulty in the Nigerian senior secondary Mathematics curriculum, *International Journal of Mathematics Trends and Technology (IJMTT), 63(3),* 157-168.
viii. Zalmon, I.G. &Wonu, N. (2017). Comparative analysis of student Mathematics achievement in West African senior secondary certificate examination in Nigeria. *European Journal of Research and Reflection in Educational Sciences, 5 (1),* 24-31.