Mathematics Curriculum Content Assessment of Seldom Taught Concepts in Senior Secondary Schools in Port Harcourt Metropolis.

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Abstract

This study examined the assessment of seldom taught concepts in the Mathematics curriculum in senior secondary schools in Port Harcourt metropolis of Rivers State. The expost-facto design was adopted for the study. The study was guided by three research questions and the Mathematics content assessment instrument (M.C.A.I.) was used in the collection of the data and its reliability was analysed with the use of Kudar-Richardson 20 (KR-20) and Cronbach alpha. The answers to the research questions were analysed using means. The results from the analysis revealed that the extent of compliance in the recording of activities had a grand mean of 8.76, which is equivalent to a high extent of compliance with record-keeping templates. It was also observed that the extent of content implementation of the intended and the implemented for senior secondary one, two and three respectively. When compared among themselves, that SS1 to SS2, SS1 to SS3 and SS2 to SS3. It was observed that it had a high extent among SS1 and SS2, SS1 and SS3, but a low extent of implementation among SS2 and SS3. In line with the results, recommendations were made accordingly in line with the observed areas of low extent in content gap implementation.

Keywords: Mathematics curriculum, Assessment

Introduction

Among the several subjects that students are constantly exposed to in varied forms from the cradle upwards is Mathematics. As a result of this, it has become imperative that concerted effort should be put in place to ensure that its contents are appropriately domesticated. According to Ose (2019), Mathematics is defined as that branch of science that deals with quantities, sizes, and shapes as determined by numbers and signs and is a tool for proffering solutions to general problems. Charles-Ogan and Deme (2016) further added that it is a gateway into the other subjects and is viewed as a way of thinking, and organizing logical proofs used in solving all kinds of problems in sciences, government, and industry and is expressed through a combination of related topics in the form of arithmetic, algebra, geometry, trigonometry, and statistics. These definitions show how utilitarian its content is not only to individuals but also the society at large.

Given the importance of Mathematics, the National Policy on Education document enumerates the aims that should guide the teaching and learning of Mathematics to help and encourage students to have the capacity to:

i. recognize that Mathematics permeates the whole world around us;
ii. appreciate the usefulness, power, and beauty of Mathematics;
iii. enjoy Mathematics and develop patience and persistence when solving problems;
iv. understand and be able to use any symbols and notations of Mathematics;
v. develop Mathematics curiosity and inductive and deductive reasoning when solving problems;
vi. appreciate the international dimensions of Mathematics and its cultural perspectives.

In line with these aims, the following are the accompanying objectives of School Mathematics as enshrined in the National policy document, they include:

i. enable the individual to think creatively and constructively in mathematical terms.
ii. enable the individual to have manipulative skills.
iii. enable the individual to apply Mathematics analysis of patterns and relationships.
iv. enable the individual to apply Mathematics in dealing with life's problems and comprehend the wide applicability of Mathematics in other disciplines such as physics.
v. enable the individual to discover, appreciate and admire the beauty and elegance of Mathematics.
vi. provide those with the necessary background the opportunities to proceed to Universities and other tertiary institutions. (FRN, 2014).

Due to its significance, the mathematics content has been organized both vertically and horizontally over time, taking into account accessibility and the significance of understanding the contents. In order to make the themes and sub-themes easier to understand and assimilate, they are further divided into subtopics. The curriculum is an amalgamation of everything that students are expected to interact with during their learning activities. The curriculum can also be thought of as the order of instructions created specifically for the students, or it can be thought of as the experiences of the students in relation to the objectives created specifically for them and encapsulated by the teachers. It considers the comprehensive approach that encompasses the educational objectives. (Eduok & Udosen, 2016; Magaji & Ogenyi, 2020).

When viewed in the context of mathematics, the mathematics curriculum is the blueprint for the learning experiences that students will have that are intended to assist them in achieving particular mathematical goals. The Mathematics curriculum is viewed as the entire course of study, which includes all work completed by the teacher, the student, the point of contact between them, and all tools used to ensure a seamless flow of information. It is also referred to as the blueprint for the experiences that students will have as well as the actual experiences they have, both of which are intended to aid them in achieving particular mathematical goals. It is referred to by other academics as the body of knowledge, abilities, and practices that can be used in a variety of ways. (Edson & Thomas, 2016; Ekwueme 2013; Remillard & Heck, 2014).
The aim of the Mathematics curriculum is geared towards helping children in the following ways:

i. develop a positive attitude toward Mathematics and to appreciate its practical applications in life,
ii. develop problem-solving skills proficiently in addition to the use of Mathematics in everyday life,
iii. use mathematical language fluently, effectively and accurately, by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
iv. understand mathematical concepts and processes at a level commensurate to their development and ability,
v. become proficient in fundamental mathematical skills and in recalling basic number facts (Mullis, Martin, Goh, & Cotter, 2016).

Despite the laudable reasons for teaching Mathematics as a subject in all school settings from the cradle upwards, the performance of many students has continued to wane and this has over time affected the output of students at various levels of external examinations. Among the several reasons for the poor performance of students are the teachers, the students, and even curricula issues.

Statement of the Problem

Scholars and educational professionals have over the years continued to suggest various teaching and learning enhancement methodologies as part of measures to improve student performance during exams and to also ensure that the content of instruction is internalized. The purpose of all of these methodologies and strategies is to improve student performance and comprehension. Some of the methodologies and strategies that have been suggested over time include the following: collaborative learning approach, constructivist instructional strategy, cooperative learning approach, group-based learning strategy, think-pair-share, guided inquiry instructional approach, etc. Others, however, have focused on using software technologies or games, such as Geogebra, Algebraton, Mathlab, Python, Mathematica, computer animations, Mathematics Scrabble, and other games based on mathematical concepts, in the teaching of mathematics.

While these efforts are admirable in and of themselves, they are insufficient because most mathematics teachers or educational professionals have yet to fully grasp how to effectively domesticate these in whatever context they are found, so their effects are infinitesimal. Given this, the main obstacle is probably not the methodology chosen, the teaching strategy or approach used, or even the software used. But the content presents a bigger

problem because it can't be taught completely and at the right time. Along with these, Akanmu (2018) added these additional elements that could influence the assimilation of mathematics content: attitudes of teachers, students (either students or pupils), parents, a lack of effective teaching strategies, and insufficient content mastery on the part of the students.

In light of these challenges, there are fundamental factors that must have contributed to the implementation gaps, thereby leading to poor performance of students and these include but not limited to incomplete content coverage, or even the lack of understanding of the taught contents, and the effect of this is expressed in the achievements of the students. This study is geared towards Mathematics Curriculum Content Assessment of Seldom Taught Concepts in Senior Secondary Schools in Port Harcourt Metropolis, Rivers state.

Aim and Objectives of the Study

The aim of this study is to assess curriculum content analysis of seldom taught topics in senior secondary Mathematics in Port Harcourt local government of rivers state.

Specifically, the objectives of this study were to:

1. To determine the content gaps between the intended and the implemented curriculum in senior secondary 1 Mathematics curriculums.
2. To determine the content gaps between the intended and the implemented curriculum in senior secondary 2 Mathematics curriculums.
3. To determine the content gaps between the intended and the implemented curriculum in senior secondary 3 Mathematics curriculums.

Research Questions

The following research questions will guide this study:

1. What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 1 Mathematics curriculum?
2. What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 2 Mathematics curriculum?
3. What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 3 Mathematics curriculum?

Methodology

The research design adopted for this study is the ex-post facto or after-the-fact research design. This research design according to Nwankwo (2013) is a category of research in which the investigation begins after the fact has occurred without the interference of the researcher. It is also a method in which the groups with qualities that already exist are compared to some dependent variables. The study was carried out in all the government senior secondary schools in Port Harcourt, Rivers State.

Port Harcourt city local government is one of the 23 local government areas in Rivers State. It has an area of about 369km^2 (142 sq. mi) which includes land and water and is bounded by the Bonny river, Obio / Akpor local government area, Okrika local government, Eleme local government area, and Degema local government area. It has a latitude of 4.824167 and a longitude of 7.033611 with Global Positioning System (GPS) coordinates of 4049’27.0012’’N and 702’0.9996’’E respectively.

The population of the study comprised all 16 public senior secondary schools within Port Harcourt, Rivers State (Ibara, 2019). For the purpose of this study, the census sampling technique was adopted for the 16 public secondary schools within Port Harcourt Local Government Areas (PHALGA) of Rivers State. In view of the size of the samples, all the public secondary schools within Port Harcourt city local government were utilized for the study. The focus of the analysis was the school diaries that served as the document to ascertain the extent of coverage of the expected content for the academic sessions from senior secondary one to three for the sixteen schools under consideration within the past five-year period beginning from 2014/15 to 2018/19.

The instrument for data collection is titled “Mathematics Curriculum Assessment Instrument” (MCAI). It was developed by the researcher under supervision of the supervisors, content readers and experts in the field of Mathematics education and measurement and evaluation. The instrument was divided into several sessions. Section ‘A’ covers the demographic details of the school, and sections B, C, and D cover the curriculum content for senior secondary one, two and three respectively. The validity of the instrument was ascertained through face, content and construct validity. The reliability of the instrument was obtained using Kuder – Richardson 20

(KR – 20) for sections B, C and D, in view of how the responses are structured in the form of either "Yes" (for content that was taught and recorded) or "No" (for contents not taught and not found recorded), the reliabilities of the sections was found to be 0.72, 0.74, and 0.76 respectively for all the sections.

The data collected through the "Mathematics Curriculum Assessment Instrument" (MCAI) was analysed using the mean generated in measuring the extent of significance among the different sections of the instrument. The table shows the sub-themes expected to be covered within the period of senior secondary one, two and three, and the contents that make up these sub-themes within the period under consideration. It also shows the mean extent of implementation among the schools that implemented each of the contents. The extent of implementation was further divided into 1-4 as very low extent (V.L.E), 5 – 8 as low extent (L.E) implementation, 8 – 12 as high extent (H.E) implementation and 12 – 16 as very high extent (V.H.E) of implementation of the content.

Results

Research Question One

What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 1 Mathematics curriculum?

Table 1: Senior Secondary 1 Mathematics Curriculum Content Implementation

Theme	**Sub-theme**	**Contents**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**	**MEAN (x)**	**Remarks**
1	Numbers & numeration	Number base system	14	14	13	10	11	12	H.E
		Modular arithmetic	8	7	7	9	8	8	LE
		Standard form / indices	13	13	12	12	13	13	V.H.E
		Logarithms	13	12	12	14	12	13	V.H.E
		Sets	10	10	9	11	9	10	H.E
2	Algebraic processes	Simple equations / variations	14	13	12	12	13	14	VHE
		Quadratic equations	13	11	12	12	13	12	H.E
		Logical reasoning	5	5	4	4	3	4	V.LE
3	Geometry	Construction	7	6	6	7	6	6	LE
		Proof of basic equations	12	11	11	12	12	12	HE
		Trigonometric ratios	10	9	9	9	10	9	HE
		Mensuration	9	8	7	8	7	8	LE
4	Statistics	Data presentation	8	8	8	7	8	8	LE
	Grand Mean ($\bar{X}$)		**11**	**10**	**9**	**10**	**10**	**10**	**H.E**

Table 1. shows the sub-themes expected to be covered within the period of senior secondary one and the contents that make up these sub-themes and the period under review. It also shows the extent of implementation among the schools to each of the contents. The extent of implementation was further divided into 0 - 4 as very low extent (V.L.E), 5 – 8 as low extent (L.E) implementation, 8 – 12 as high extent (H.E) implementation, and 12 – 16 as very high extent (V.H.E) of implementation of the content. As shown in table 2, the items have a very high extent (V.H.E) of implementation, and these are in the areas such as Number base system, Standard form/indices, Logarithms under number and numeration, Simple equations/variations, and Quadratic equations under algebraic processes. It also has 3 cases of high extent (H.E) in the implementation of contents in areas such as Sets under number and numeration, proof of basic equations, and trigonometric ratios under geometry. The table further reveals 4 areas of low extent (L.E) of implementation in Modular arithmetic under number and numeration, under algebraic processes, construction and mensuration under geometry, and data presentation under statistics. It also has one case of very low extent (V.L.E) of implementation in logical reasoning under algebraic processes. This is despite the fact that on a general note the grand mean of implementation is 10.

Research Question Two

What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 2 Mathematics curriculum?

Table 2: Senior Secondary 2 Mathematics Curriculum Content Implementation

Theme	Sub-theme	Contents	2014/15	2015/16	2016/17	2017/18	2018/19	Mean (x)	Remarks
1	Number & numeration	Logarithms	14	13	13	12	12	13	V.H.E
		Approximation	13	11	12	11	10	11	H. E
		Sequence & series	12	11	10	12	11	11	H. E
2	Algebraic processes	Quadratic equation	14	13	14	12	13	13	V.H.E
		Simultaneous linear & quadratic equation	13	12	12	10	11	12	H. E
		Gradient of a curve	12	11	9	11	10	11	H. E
		Logical reasoning	5	6	7	7	4	6	L. E
		Linear inequalities	6	7	5	6	6	6	L. E
		Algebraic fractions	13	11	12	13	11	12	H.E
3	Geometry	Chord properties	10	10	12	10	11	11	H. E
		Circle theorems	7	8	7	7	7	7	L. E
		Trigonometry	7	6	5	6	7	6	L.E
4	Trigonometry	Bearing	5	4	6	3	5	5	L. E
5	Statistics	Measures of central tendency	13	12	11	13	12	12	H. E
		Measures of dispersion	12	11	12	11	10	11	H. E
		Histogram of grouped data	10	9	10	11	10	10	H. E
		Cumulative frequency graph	10	9	11	10	9	10	H. E
		Measures of central tendency grouped data	9	9	8	8	7	8	L.E
		Probability	5	6	7	7	6	6	L.E
	Grand Mean		10	9	10	10	9	10	H.E

Table 2. shows the sub-themes expected to be covered within the period of senior secondary one and the contents that make up these sub-themes and the period under review. It also shows the mean extent of implementation among the schools that implemented each of the contents. The extent of implementation was further divided into 0 - 4 as very low extent (V.L.E), 4 – 8 as low extent (L.E) implementation, 8 – 12 as high extent (H.E) implementation, and 12 – 16 as very high extent (V.H.E) of implementation of the content. As shown in table 2, the items have a very high extent (V.H.E) of implementation, and these are in areas of logarithms under number and numeration and quadratic equations under algebraic processes. It also has 10 cases of high extent (H.E) in the implementation of contents in areas such as approximation, sequence and series under number and numeration, simultaneous linear and quadratic equation, a gradient of a curve under algebraic processes and chord properties under geometry, measures of central tendency, measures of dispersion, histogram of grouped data and cumulative frequency graphs under statistics. It was also revealed that there were 7 areas of low extent (L.E) of implementation in logical reasoning and linear inequalities under algebraic processes, circle theorems, and trigonometry under geometry, bearing under trigonometry, measures of central tendency of grouped data, and probability under statistics. This is despite the fact that on a general note the grand mean of implementation is 10.

Research Question Three

What content gaps were observed between the intended and the implemented Mathematics curriculum in Senior Secondary 3 Mathematics curriculum?

Table 3.: Senior Secondary 3 Mathematics Curriculum Content Implementation

Theme	Sub-theme	Contents	2014/15	2015/16	2016/17	2017/18	2018/19	Mean (X)	Remarks

1	Number and numeration	Surds	13	12	11	12	13	12	H.E
		Matrices & determinants	9	8	7	8	7	8	L.E
		Logarithms	10	11	10	10	11	10	V.H.E
		Arithmetic of finance	8	9	7	7	8	8	L.E
2	Algebraic processes	Application of linear and quadratic equations to capital market	9	9	8	7	8	8	L.E
3	Geometry	Trigonometry graph and ratios	5	6	6	5	5	5	L.E
		Surface area and volume of sphere	8	8	8	9	8	8	L.E
		Longitude and latitude	5	6	4	5	4	5	L.E
		Coordinate geometry of straight lines	8	9	8	8	9	8	L.E
4	Introductory calculus	Differentiation of algebraic fractions	5	4	5	3	4	4	V.L.E
		Integration of simple functions	4	4	5	3	4	4	V.L.E
		Applications	3	2	3	2	2	2	V.L.E
	Grand Mean		8	7	7	7	7	7	L. E

Table 3. shows the sub-themes expected to be covered within the period of senior secondary one and the contents that make up these sub-themes and the period under review. It also shows the mean extent of implementation among the schools that implemented each of the contents. The extent of implementation was further divided into 0 - 4 as very low extent (V.L.E), 5 – 8 as low extent (L.E) implementation, 8 – 12 as high extent (H.E) implementation, and 12 – 16 as very high extent (V.H.E) of implementation of the content. The table shows that out of the items to be taught in senior secondary three, 5 of the items have a high extent (H.E) of implementation, and these are in areas such as surds, logarithms under number and numeration, application of linear and quadratic equations to capital market under algebraic processes, surface area and volume of a sphere, coordinate geometry of straight lines under geometry. The table also reveals that there were 4 areas of low extent (L.E) of implementation in matrices and determinants, the arithmetic of finance, trigonometry graph and ratios, longitude and latitude under geometry, and 3 cases of very low extent (V.L.E.) of implementation in areas of differentiation, integration and its application under introductory calculus. This is despite the fact that on a general note the grand mean of implementation is 7, which shows a low implementation of contents.

Discussion of Findings

Table 1 showed that on average, the extent of record keeping for those that complied with the record keeping templates as required by the Education Board were 11, 10, 9, 10, 10, with regards to the years under consideration, with an average of 10. It also revealed the extent of implementation among the contents of the curriculum However, the focus is on the areas of low and very low implementation rates for the senior secondary one curriculum contents. A low extent of implementation of the Mathematics contents was observed in areas such as Modular arithmetic under number and numeration, under algebraic processes, construction and mensuration under geometry, and data presentation under statistics. It also had a case of very low extent (V.L.E) of implementation in logical reasoning under algebraic processes.

Table 2 showed that on average, the extent of record-keeping for those that complied with the record-keeping templates as required by the Education Board were 10, 9, 10, 10, and 9, respectively for the period under review. It also revealed that there were 7 areas of low extent (L.E) of implementation in areas such as logical reasoning, linear inequalities under algebraic processes, circle theorems, trigonometry under geometry, bearing under trigonometry, measures of central tendency of grouped data, and probability under statistics.

Table 3 showed that on average, the extent of record keeping for those that complied with the record-keeping templates as required by the Education Board were 8, 7, 7,7, and 7. As shown from the table, the areas that had a low extent (L.E) of implementation were 4 and in areas such as matrices and determinants, the arithmetic of finance, trigonometry graph and ratios, longitude and latitude under geometry, and 3 cases of very low extent (V.L.E.) of implementation in areas of differentiation, integration and its application under introductory calculus.

The findings from the study align with that conducted by Athanatius (2020) while assessing the implementation of senior secondary school Mathematics curriculum in Abakaliki education zone that the curriculum content for all the classes in the senior secondary was just fairly covered, implying that there was a gap between the

intended curriculum content and its implementation. This was also in tune with the findings of Igboko and Inekwe (2019), where it was observed that the absence of qualified teachers is also a major variable towards the low extent of content coverage of further Mathematics and by extension Mathematics. Mkhwanazi et al. (2018) also observed that a major challenge towards the non-implementation of curriculum content was as a result of the non-supervision of teachers by heads of departments and others in the education hierarchy that are saddled with the responsibility to ensure that what is recorded is what they actually taught, thereby corresponding with that found in the curriculum tracker and the students' books. (Oginni, Ojo, & Daramola, 2018). The areas of the low extent and very low extent of implementation of Mathematics curriculum content were supported by the findings of Wonu and Zalmon (2017), in their study of the diagnosis and remediation of senior secondary students' common learning difficulties in Mathematics. It was observed that students did not have learning difficulties in most contents under number and numeration, algebraic processes and statistics. However, it was observed that most students had difficulties in the contents of geometry and introductory calculus. Athanatius (2020) also observed in the study on assessment of the implementation of senior secondary school Mathematics curriculum that concepts such as number base. The length of arc of a circle, mensuration of solid shapes, and geometric ratios were fairly covered. While trigonometric ratios as related to units and locus of moving points were not covered at all. The findings from the study of Charles-Owaba (2019) show areas of difficulty which eventually contributed to gaps in the Mathematics curriculum content in areas such as statistical representations, cumulative frequency curves, measures of central tendency, measures of spread and probability.

Conclusions

From the findings, some major determinants towards the poor performance of most students in external examinations are borne out of the fact that most the areas in the curriculum at various levels have low and, in most cases, a very low extent of curriculum content implementation. In effect, these were not taught, or they were done on the periphery. These among others are because of the lack of infrastructure, few Mathematics teachers and many learners, use of underqualified teachers and persons from other disciplines that are science-based but not directly related to Mathematics, and lack of continuity due to the transfer of teachers. Teachers' inability to comprehend some of the difficult topics that they find challenging and skipping these as measures to avert embarrassment while teaching.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Mathematics teachers should be checkmated and notified always in the areas lacking implementation so that these can be addressed early in order to forestall further poor performance during external examinations.
2. In-service training of Mathematics teachers should be done, focusing on the areas of the Mathematics curriculum that are difficult for teachers to enable them to cope with instead of avoiding difficult topics to the detriment of the students.
3. State government should employ an adequate number of qualified Mathematics teachers that will handle the subjects effectively. The availability of qualified Mathematics teachers enhances effective lesson delivery.

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