**International Journal of Education and Humanities (IJEH), 3(2) 2023:152-166**
http://i-jeh.com/index.php/ijeh/index
e-ISSN: 2798-5768

# Espial of Concept Difficulties in the New Africans' Secondary School Mathematics Curriculum: CTCA Recommended

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**Abstract**
The value of teaching-learning the subject mathematics has been one of the foremost challenges and concerns of educators. This study employed a mixed method design aimed at investigating difficult concepts in the new senior secondary mathematics curriculum as perceived by students in Ghana and Nigeria. Guided by two research questions and the sample was 1,252 SS 1-3 students from 34 public and 66 private senior secondary (SS). The students are from both urban (62.9%) and rural (35.1%). The mean age of the students was 15 years, the class streams are science, commercial, and arts classes. The instruments were validated and the reliability was established using Cronbach's Alpha method, and a reliability index of 0.78 using the test-retest method. The data obtained were analyzed using mean ranking in the IBM-SPSS 23 and Ms. Excel for qualitative analysis into themes and graphical representations. From the data gathered, we found 39 topics that students perceived to be difficult in the new mathematics curriculum. It was recommended amongst others that the CTCA should be used for the teaching-learning of mathematics in African schools based on its effectiveness in STEM related subjects in African and beyond.

**Keywords**: *Mathematics curriculum, Difficult concepts, Teaching-learning, STEM subjects*

## A. Introduction

In modern world, mathematics is being increasingly used in sciences, technologies, social science, education and other subjects. With the use of computer and other devices there is a more emphasis in mathematics. Though the world is more mathematically inclined, the majority of students in school feel it as more abstract. The significance accorded mathematics in the school curriculum right from primary to secondary school level reveals the vital role played by the subject in our entire society. At the secondary school level, the knowledge of mathematics is expedient in the conduct of everyday living and in engineering, natural and social sciences. One contest facing the field of mathematics education is how to plan instruction on concepts that can meet the needs of diverse learners. An innovation that shows promise is to base instructional design upon well-established trajectories of students' teaching and learning (Martin, & Hunt, 2022). Hence mathematics is seen as a service subject that supplies the necessary support needed by each subject being taught so as to arrive at their desired goal or objective. The national policy on education (NPE) 2014 put the philosophy of secondary Mathematics education as a preparation for life and making a rational decision (Gbemiga, 2022).

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Mathematics is used every day by everyone, especially in this present scientific and technological world. The emphasis in Nigeria today is on technological development and mathematics is needed for this technological development. Linking Mathematics to development and progress through science and technology Mathematics is fundamental for many professions, especially science, technology, and engineering. Yet, mathematics is perceived as a difficult subject and many students leave disciplines in science, technology, engineering, and mathematics (STEM) as a result, closing doors to scientific, engineering, and technological careers (Li, & Schoenfeld, 2019).

In line with this relationship between Mathematics, Science, and Technology, Agbeje, (2021) remarked that mathematics remains the pivot on which any true science can rest and no true science can succeed without going through mathematical demonstration; that any nation that wants to develop technologically begins by developing her mathematical arts right from the classroom. In other words, mathematics and science are important in our daily lives. It is this importance of mathematics that has made Ukeje in Onah (2004) to stress that without mathematics, there is no science; without science, there is no modern technology, and without modern technology, there is no modern society. The implication of this statement is that there could be no real development, technologically without a corresponding development in mathematics.

According to Abdullahi, 2013) many problems are encountered in the teaching-learning of mathematics in secondary schools leading to the poor achievement of students in the subject. Abakporo (2005) expressed worries about the poor performance of students in Mathematics and presented a table showing year by year poor performance of students in mathematics in May/June external examinations for 14 consecutive years. WAEC 2006 and WAEC 2007 recorded poor performance of students in branches of mathematics curriculum from chief examiners‟ report.

Also, from WAEC results in the years 2008, 2009, 2010 and 2011, the percentage pass in mathematics with credit and above in Nigeria were 23.00%, 31.00%, 24.94%, and 38.998% respectively (WAEC, 2012). Sardauna, & Musa, (2013) also observed that candidates recorded mass failure in 2013 WASSCE examination. To be precise, Dike indicated that only 29% made a 5 credit grade in their subjects, including English and Mathematics, that candidates who sat for the 2013 West African Senior School Certificate Examination (WASSCE) recorded mass failure as only 86,612 candidates, out of the 308,217 candidates that participated in the examinations obtained five credits (including English and Mathematics)The above citations indicate that students perform poorly in Mathematics in both May/June and Nov/Dec external examinations. Comparing 2011 and 2012 WASSCE, there is a marked decline in candidate's performance. Egunidu (2013) stated that in 2011 only 139,872 candidates representing 36.07% passed English and Mathematics while in year 2012, only 150,615 candidates, representing 37.97% obtained 5 credits in their subjects, including English and mathematics. For May/June 2011 and 2012 WASSCE, Uzoechi, Kurumeh & Azuka (2013) stated as follows: Only 38.98% of candidates who sat for the May/June, 2011 West African secondary school certificate examinations obtained a credit and above in mathematics.

The public relations officer of the West African Examination Council, WAEC, in Ghana, Agnes Teye Cudjoe, has revealed two factors responsible for mass failure in English in the 2018 WASSCE result.). Provisional results released by WAEC showed that 99, 402 which represents (31%) obtained D7-E8 in the English Language, 94, 607 which represents (30. 09%) obtained D7-E 8 in Mathematics, and109, 069 which represents (34.72%) also obtained D7-E8 in Integrated Science. This percentage is still low as educators in the field are worried and improvement is needed. "With respect to Mathematics, the 2018 Chief Examiners report revealed that the major challenge for the candidates was as a result of their inability to translate story problems into mathematical statements.

Agwagah (2017) stated many causes of poor performance of students in Mathematics, which if well solved would help the students improve on their academic performances in the subject. Several reasons were found to include; Poor method of teaching applied by the teachers in the classroom; students' lack of interest and/or negative attitude towards mathematics; lack of qualified mathematics teachers; teachers' own negative attitude and/or incompetence in certain concepts; and teachers' non-use of instructional materials in the teaching of mathematical concepts especially some that seem abstract.

The above causes if well tackled may reduce the problem of poor performance of students in mathematics. Since students perform poorly in mathematics, especially in branches of mathematics which is found in almost every external examination in mathematics, educators in the field are looking for different methods to solve the problem of poor performance of students in mathematics. Mathematics is made up of various branches like probability, statistics, algebra, geometry trigonometry, number /numeration, and so on. To this end, it is vital to know the areas of mathematics that are African secondary school students find difficult in the new mathematics curriculum that this research focuses on. This study specifically covers the topics from SS 1-3.

In this paper, "topic" and "concept" are used interchangeably. In the typical African secondary science curriculum, the label "topic" is commonly used as a descriptor of what students are expected to learn. For flowchart, programming language, and logic gate are listed as topics in the senior secondary computer studies curriculum in many African schools, whereas in the curriculum literature (Gbeleyi et al., 2022), these "topics" are often labelled as "concepts" (Gilbert, Bulte, & Pilot, 2011). We have the concept of algorithm, high-level language and machine language which are large subsets of the topics of programming language. We stress that it is not the intention of this paper to undertake an academic hair-splitting of the two labels as we have operationally defined both topic and concept as components of the subject matter in the school curriculum that students are expected to learn.

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 the 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 & Carpenter (1992) and Janvier, Giorardon & 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 & 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 (2019) 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.

A mixed-method (quantitative and qualitative) design was adopted to collect data for this study. In doing so, two instruments were developed; the difficult concepts in Mathematics questionnaire (DCMQ) and the difficult concepts in Mathematics interview guide (DCMIG). Participants in this study were 1,252 mathematics students from 34 public and 66 private senior secondary schools in Lagos and Osun state, Nigeria and Accra, Ghana. Randomly, 12 schools were selected from Lagos state, eight schools from Osun state, and four school from Accra. The mean age of the students was 15 years, the class streams are science, commercial, and arts classes. About 51% of the respondents were females while about 49% were males. A larger percent of the schools covering about 75% were schools in the urban areas of Lagos, Osun and Accra. When categorised by school type, 35.1% of the respondents were from private schools while 64.9% were students of public schools.

The DCMQ was used to collect quantitative data for the study. It had five sections. Before section A is on demographic Data. Section B had 22 concepts drawn from the national curriculum for mathematics in Nigeria and Ghana placed on a three-point rating scale of very difficult, moderately difficult and not difficult. The validation exercise was conducted by 16 experts in science, and science education department, section B requires expertise from the ERT mathematics group on the basis of experiences in curriculum development, marking and supervision of WAEC, and content validity just as that of the section D. The team also recommended that a section on related factors be added to the instrument in other to strengthen its reliability, hence for section C. Section E was the last section which contain open-ended item on submissions for improvement. The test-retest reliability coefficient of 0.79 was obtained for the instrument.

The Difficult Concepts in Mathematics Interview Guide (DCMIG) was the qualitative instrument used to elicit responses from the twenty-two randomly selected participants comprising twelve females and ten males from five public schools and four private schools.

The instrument contained only four basic questions; List five concepts you consider most difficult to learn in mathematics? Please explain why you find each of these concepts difficult to learn. Please suggest ways by which understanding of these concepts can be made easy for chemistry students, and suggest two teachers factors on the difficult topics.

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.

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, and 2. Ascertain the causes of the identified difficult mathematics concepts in the senior secondary school curriculum as perceived by the students.

## B. Methodology

A mixed-method (quantitative and qualitative) design was adopted to collect data for this study. In doing so, two instruments were developed: Difficult Concepts in Mathematics Questionnaire (DCMQ) and the difficult concepts in Mathematics interview guide (DCMIG). The sample consisted of one thousand two hundred and fifty-two (1252) SS 1-3 students from Ghana and Nigeria. The schools located in different parts of Ghana and Nigeria education district were purposefully selected to prevent students in each group from interacting with one another. Our choice of the study area was prompted by the record of high failure rate of students in mathematics and the general lack of interest in the subject (Gbeleyi, 2020).

The instrument was based on the current national mathematics curriculum for senior secondary school. DCQM 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 =3, moderately difficult =2, and not difficult. 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. This was later recoded into same variable of Yes and No for the qualitative analyses. 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 0.78 using the test-retest method. The data obtained were analyzed using mean. The criterion mean for each item in both sections of DCQM was 2.5.

The DCMQ was used to collect quantitative data for the study. It had five sections. Section A collected demographic data. Section B had 38 topics (see table 1) drawn from the new Mathematics syllabus used by all schools in Nigeria and Ghana. The section had a three-point rating scale of very difficult, moderately difficult, and not difficult. Section C sought to know from the respondents, the factors influencing their perception of the difficulty of the topics. This section has a listing of reasons for the difficulties, derived from a pilot study and placed on a four-point rating scale of Strongly Agree (SA), agree (A), disagree (D), and strongly Disagree (SD). Section E sought their suggestions for improvement. Validation of DCCSQ was conducted by a team of 12 experts in science and technology education. Upon endorsement of validity, the test-retest reliability coefficient of the instrument after two weeks of administration was found to be 0.79.

After seeking permission from school authorities to conduct the study (principals of public schools and in some cases of private schools, the proprietor) the research team ensured a friendly atmosphere wherein the respondents felt relaxed and ready to participate (this was achieved with the help of the school mathematics teacher in some cases particularly in public schools). Information which was not readily available to the respondents (such as teacher's qualification and years of experience) were provided on a general note. The last stage of the quantitative data gathering exercise was to ensure that all participants signed the attestation statement on the questionnaire which expressed freedom of participation and willingness to do so under the authority of the school. The Difficult Concepts in Mathematics Interview Guide (DCMIG) was administered after the questionnaires were completed. On the average, six of the participants from each school were interviewed through phone calls while four were interviewed face to face.

IBM-SPSS Version 23 was used to analyse the data generated from the questionnaires. After the initial raw analysis of the three-point scale of not difficult, moderately difficult and very difficult and the four-point scale of strongly agree, agree, disagree and strongly disagree, for parsimony, clustering into difficult or not difficult and yes or no were achieved via data transformation (see table 2). In the data coding process, not difficult was scored 1, moderately difficult=2, very difficult=3. For each respondent, it was then possible to get a difficulty score which ranged between 1 and 3. The mean rank method (Okebukola,1986; 1987) was used to answer the main research question of the study.

## C. Findings and Discussion

The data collected were analyzed using mean rank analysis to determine the perceived difficulty level of each of the 39 concepts highlighted in the questionnaire. Table 1 presents the results of the analysis.

**Table 1** Mean Rank Analysis on Difficult Concepts in Mathematics *(N- 1252)*

| S/N | Topics | Mean score | Rank |
|---|---|---|---|
| 1 | Differentiation and integration | 31.5 | 1st |
| 2 | Algebraic fractions | 30.2 | 2nd |
| 3 | Bearing and distances | 30.1 | 3rd |
| 4 | Geometrical construction | 29.0 | 4th |
| 5 | Circle theorems | 27.9 | 5th |
| 6 | Linear programming | 27.9 | 6th |
| 7 | Arithmetic of finance | 26.9 | 7th |
| 8 | Longitude and latitude | 26.6 | 8th |
| 9 | Trigonometry ratios | 26.4 | 9th |

| S/N | Topics | Mean score | Rank |
|---|---|---|---|
| 10 | Set theories | 26.0 | 10th |
| 11 | Coordinate geometry of straight line | 25.6 | 11th |
| 12 | Application of sine, cosine and tangent of angles | 25.5 | 12th |
| 13 | Matrices and determinant | 25.4 | 13th |
| 14 | Sine and cosine rule | 25.4 | 14th |
| 15 | Basic operations of integers | 25.3 | 15th |
| 16 | Cumulative frequency graph | 25.2 | 16th |
| 17 | Simultaneous linear linear equation | 25.2 | 17th |
| 18 | Measure of central tendency | 25.1 | 18th |
| 19 | Mensuration | 25.1 | 19th |
| 20 | Measure of dispersion | 25.0 | 20th |
| 21 | Construction of quadratic equation from sum and product roots | 24.8 | 21st |
| 22 | Concept of module arithmetic | 24.5 | 22nd |
| 23 | Logarithm numbers greater than 1 | 24.4 | 23rd |
| 24 | Straight line graph | 24.3 | 24th |
| 25 | Simultaneous equation: one linear and one quadratic | 23.9 | 25th |
| 26 | Statistical graph | 23.6 | 26th |
| 27 | Surds | 23.2 | 27th |
| 28 | Changes of Subject of formulae | 23.1 | 28th |
| 29 | Linear inequalities | 23.0 | 29th |
| 30 | Logic | 22.9 | 30th |
| 31 | Theory of logarithms | 22.8 | 31st |
| 32 | Approximation and percentage error | 22.5 | 32nd |
| 33 | Linear and quadratic equation | 21.6 | 33rd |
| 34 | Indices | 20.9 | 34th |
| 35 | Sequences and series | 20.4 | 35th |
| 36 | Probability | 19.9 | 36th |
| 37 | Standard form | 17.5 | 37th |
| 38 | Number bases | 17.3 | 38th |

In table 1, differentiation and integration (31.5) are perceived as the most difficult concept in the new curriculum senior school mathematics, followed Algebraic fractions (30.2), while bearing and distances (30.1) ranked the fourth most difficult concept and the least is number bases (17.3). Additional, table 1 showed that circle theorems, Linear programming, Arithmetic of finance, Longitude and latitude, Trigonometry ratios in addition to the aforementioned concepts are perceived as most difficult in senior school mathematics with mean value ranging from 29.0 to 26.4.

Mathematics plays a key role in shaping how individuals deal with the various spheres of life, be it private, social or cooperative. Reforms are very important in any society that intends to change, we are aware that Mathematics is a driving force of change, especially in technology, so it becomes necessary for Mathematics to constantly undergo reforms that will meet the yearnings of the people who equally require changes at any point in time. A cursory look at the national curriculum for mathematics reveals the concept's applicability of mathematics knowledge in our formal and informal daily activities. Students of the subject matter have challenges in effectively learning mathematical processes. Therefore, the need for reform to what we have today, new mathematics curriculum (NMC).

The national curriculum for Nigeria and Ghana stipulates that mathematics students are expected to learn the following contents in differentiation and integration at the senior school level. Right now, the Federal Ministry of Education through the Nigerian Educational Research and Development Council (NERDC) has introduced a new mathematics curriculum for all classes in secondary schools. The new mathematics curriculum for junior and senior secondary schools came into effect in 2009. In this new mathematics curriculum, new topics were introduced especially at the senior secondary school level. In fact, there were topics in further mathematics curriculum that have been drafted into the core mathematics curriculum. From my experience as a secondary school mathematics teacher, there were some mathematics teachers that are not aware of the new development in core mathematics. This group of mathematics teachers still based their mathematics teaching using the lesson plans/notes prepared before the introduction of the new mathematics curriculum. For instance, topics like matrix, differentiation, and integration of algebraic expressions among others, are some of the new topics introduced into the new mathematics curriculum at the senior secondary school level.

Studies have shown that students' performance in mathematics is a function of many variables including teachers' characteristics, teachers' activities, and pupils background (Badmus, 1995). Presentation of mathematics scheme of work to the students by the mathematics teacher at the beginning of each academic term formed part of the teachers' activities in the classroom. As a secondary school mathematics teacher, it is my kind opinion that the copy of the mathematics scheme of work should be given to all students instead of making it secret to them. We are in the era of ICT where the students learn mathematics from different sources. As we all know, the scheme of work emanates from the approved new mathematics curriculum (Aduwa, 2021).

The information below gives the mathematics scheme of work for ss1, ss2, and ss3. This will help both teachers and students know areas to concentrate on and help teachers to write their lesson plans. Mathematics is one of the core subjects to pass in WASSCE and NECO and one of the keys to success in the exam is to know the topics you are to concentrate on and solve all related questions to those topics in the syllabus.

The mathematics scheme of work for SS 1, SS 2, and SS 3 has been developed to ensure a comprehensive curriculum.

Mathematics (maths) SS 1- first term:
Number and Numeration
Number Base System
Modular Arithmetic
Logarithms and indices
Sets …

Mathematics SS 1- second term:
Algebraic Process
Simple Equations and Variations
Quadratic Equation
Logical Reasoning
Geometry
Constructions …

SS 1- Third Term:
Geometry (Cont'd)
Proofs of Some Basic equations
Trigonometric Ratios
Mensuration
Statistics
Data Presentation …

Mathematics SS 2- First Term:
Logarithm
Approximations
Sequence and Series
Quadratic equation
Simultaneous linear and Quadratic Equations
Gradient of a Curve …

SS 2- Second Term:
Logical Reasoning (Revision)
Linear Inequalities
Algebraic Fractions
Chord Property
Circle Theorems
Trigonometry …

SS 2- Third Term:
Bearings
Measures of Central Tendency
Measures of Dispersion
Histograms of Grouped Data (Revision)
Cumulative Frequency graph
Measures of central tendency for grouped data
Probability …

Mathematics SS 3- First Term:
Surds
Matrices and determinants
Logarithm
Arithmetic of finance
Longitude and latitude …

SS 3- Second Term:
Application of Linear and quadratic equations to capital market etc.
Trigonometry Graphs of Trigonometric Ratios
Surface Area and volume of sphere
Coordinates geometry of straight lines
Differentiation of Algebraic fractions
Integration of simple Algebraic functions …

The second research question was on the specific difficulty students have with learning the three perceived most difficult topics. Interview data revealed that regarding differentiation and integration which students found most difficult to learn. For research question two on the reasons for concept difficulty in mathematics, our findings are reported in Figure. 1.

In the course of the interview, participants were asked to explain why they find mathematics difficult to learn and to suggest ways by which the concept can be made easy to learn for mathematics students. Figure 1 presents percentages of the participants' responses to these reasons. These include; 'I struggle to understand mathematics; learning environment is not conducive; the syllabus is too wide, no practical sections and so on.

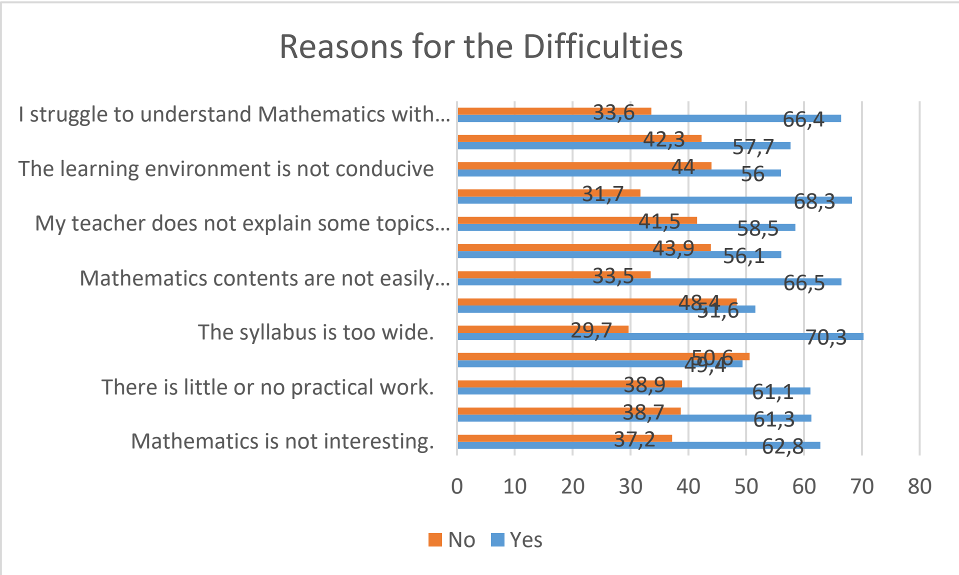


**Figure 1**. Reason for the concept difficulty in mathematics

Literature on teaching methods and theories in recent times are bereft of African theorists. Yet, ample studies have shown that many students within the African region find some concepts difficult to study (See Awaah, Arkorful, Foli, Darteh & Yeboah, 2021; Awaah, Okebukola, Ebisin, Agbanimu, Peter, Ajayi, ... & Ademola, 2020; and Awaah, Okebukola, Alfa, Anagba, Yeboah & Arkorful, 2021). Other studies in the sciences such as Egerue (2019), and Saanu (2015), have equally found some concepts difficult for students to learn. These findings have implications for the quality of teaching and learning within the African region, with academic dishonest practices on the rise as a result of the difficulties in studying subjects among students (See Awaah, 2019). These findings, coupled with other studies are pointers to indigenous methods as the preferred way to ensure quality teaching (Raheem, Anamuah-Mensah & Dei, 2014), necessitating a desk review of studies that have tested the CTCA in a bid to unveil the gaps in the theory/ approach towards an enhanced educational system within the African region.

In furtherance to this, other works within the COVID-19 pandemic reveals the importance of technology as an effective tool for teaching and learning especially within the African region (See Okebukola, Gbeleyi, Onowugbeda, Awaah, Ademola, Odekeye &

Ajayi, 2020; Okebukola, Suwadu, Oladejo, Nyandwi, Ademola, Okorie, & Awaah, 2020). These findings further necessitate an examination of the efficacy of the CTCA since the 'T' component is relative to technology.

Studies that had tested the CTCA have been selected for this review. This section catalogs the findings of the studies which have been analysed in line with relevant literature and the researchers' opinions.

In a study on the effect of the Culturo-Techno-Contextual Approach on the achievement and attitude of students in logic gate, Saanu (2015) investigated the efficacy of the CTCA on the achievement and attitude of students in logic gate. He sought to establish whether (a) the use of the CTCA will enhance the achievement of students in logic gate (b) the use of the CTCA will enhance the attitude of students to logic gate. Using a purposive sample of an intact class of thirty students of mixed-sex, the results of his study showed a statistically significant difference between CTCA and lecture method in students' achievement in logic gate [F (1, 59) = 15.261; p<0.05].

The study established CTCA as a better method of enhancing students' understanding compared to the lecture method. Saanu's study finds further support in the works of subsequent authors in the area of computer studies. For instance, the works of Agbanimu (2020), Peter (2020) and Gbeleyi (2020); (2022) are reflective of how cultural knowledge enhances student understanding of concepts in the Nigerian computer education curriculum. In the Agbanimu (2020) study, she asserted that Algorithm and flowcharts in computer studies are concepts perceived as difficult by senior secondary students. She further suggested that the teaching and learning of ICT using the CTCA should be supported by education policymakers, teacher educators, school administrators and teachers. Trained secondary school teachers should not only be facilitated but encouraged to use technologically integrated teaching strategies for teaching and also relate it to learner's cultural backgrounds and what they can see in the environment.

In the Onowugbeda (2020) study, he argued that it is possible integrating indigenous (cultural) knowledge in the biology classroom to support meaningful learning and cultural sustainability. Learning the concept of sustainability is essential to learners' future, thus, integrating indigenous knowledge is required to link the space and gaps that occur in the mind of students. Indigenous (cultural) knowledge helps student think on the advocates of life and protect nature and culture from over-exploitation.

With a sample of 566 from 3 Ghanaian universities for the survey phase and 2 intact classrooms of mixed-sex and mixed abilities in the experimental phase, the Awaah (2021) study investigated the efficacy of the CTCA in student understanding of bureaucracy and politics as difficult concepts in the study of public administration. Results of his study showed that Ghanaian university students, when taught public administration within the remits of their culture backed with the use of technology and the context within which the topic is being taught, result in better-performing students than when taught using the lecture method.

Based on these successes, there is a need to (a) continue testing the invention on many subjects within the African region; (b) there is need to test the efficacy of the invention with larger samples to establish its generalisability, or otherwise (c) other regions of the world need to test the invention to establish its efficacy or otherwise.

This study investigated concepts in the new mathematics curriculum that are perceived as difficult by African students. The top ten topics in order of perceived difficulty were found to be differentiation and integration, algebraic fractions, bearing and distances, geometrical construction, circle theorems, linear programming, arithmetic of finance, and longitude and latitude, trigonometry ratios, and set theories. The topics perceived to be easy in increasing order of easiness were linear inequalities, logic, theory of logarithms, approximation and percentage error, linear and quadratic equation, indices, sequences and series, probability, standard form, and number bases. Since the students in Ghana and Nigeria had been taught these topics before their senior school certificate examination in mathematics, we were confident of the reliability of their claim. The performance profile on these topics of students who had taken the examination in mathematics is also reflective of the difficulty levels as reported in the mathematics chief examiners' reports.

## D. Conclusions

The primary aim of this study was to inquire into topics or concepts that secondary school students in Africa (sampled from Ghana and Nigeria), find difficult to learn in mathematics and conduct a deep probe into the aetiology of such difficulties. We found the top ten topics in order of perceived difficulty to be differentiation and integration, Algebraic fractions, Bearing and distances, Geometrical construction, Circle theorems, Linear programming, Arithmetic of finance, Longitude and latitude, Trigonometry ratios, and Set theories. We gained extensive deeper insights into specific aspects of the topics inducing difficulty in learning the top five of these topics. For instance, we found students to have difficulty with differentiation and integration, that the topic is not interesting, learning environs not conducive and they struggle to articulate word problems. Also, many of the students also linked the weak content knowledge of differentiation and integration by the teacher, expressed in the inability to satisfactorily explain the differentiation and integration to students as impeding meaningful learning of the concept.

The study also implicated a number of factors in students' perception of difficulty of topics in the new mathematics curriculum. These factors, as can be seen in Fig. 1 include overloaded mathematics curriculum; inadequacies in maths laboratories and teacher capacity deficit. While the intention is not to generalize beyond our samples drawn from Ghana and Nigeria, based on our findings, we consider it expedient to offer the following recommendations: 1. The new mathematics syllabus for anglophone West Africa as developed by the WAEC should be reviewed to reduce its content load, enhance its relevance, emphasize emerging topics, and demand an emphasis on practical work. In examining the syllabus, test items should demand the understanding of the skills aspects of the topics rather than the theory; 2. Refresher courses should be organised for mathematics teachers on how to better deliver topics that are perceived difficult to learn by students especially the top 10. In such topics, emphasis should be on what this study revealed to be the aspect of each topic that students had difficulty with; 3. Mathematics laboratories should be better resourced and students exposed to hands-on laboratory work to make the topics real hence promote meaningfully learning. Special attention should be paid to better resourcing of mathematics laboratories in rural schools. Experienced teachers should be motivated to offer service in such schools; and 4. Further research should be conducted on methodologies for making the perceived difficult topics found in this study, easy to learn. One of such studies exploring the impact of the CTCA, is currently underway.

**Disclosure statement**

No potential conflict of interest was reported by the author(s).

**Declaration of conflicting interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) disclosed receipt of the following financial support for this article's research, authorship, and/or publication: This article was not supported by the orgainisation.

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