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## Uniqueness of Mathematics and Diverse Objectives in the School System

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### Abstract

*There is no argument on the uniqueness of mathematics in the school curriculum as it serves as an important weapon of understanding salient issues in the world. Anchored with five research questions, study surveyed the tasks given to students by mathematics teachers in a randomly selected 5 secondary schools in Oto-Awori local council development area of Lagos State. Mathematics teachers made choices in selecting tasks efforts which were geared towards the stated objectives of mathematics as entrenched in the curriculum, the study observed some tasks that could be learners' support and active in the classroom; and lead to diverse attainable objectives were found lacking due to absent teaching methods or strategies adopted by mathematics teachers in the classrooms. As a result, findings, implications and recommendation were discussed.*

**Key words:** Uniqueness, mathematics curriculum, objectives, school system

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### Introduction:

Mathematics is an important subject as it occupies a central position even from the inception of the ancient civilization to the contemporary since there is no doubt about its relevance in serving the interest of many nations in the world in general and of students in particular (Raimo, Markku, Anu, & Erkki, 2008). These differences are most pronounced in between the aspiration and achievement of most mathematics students. Many students feel that mathematics is highly abstract, in the sense that, it is concerned with ideas rather than objects. Mathematics is concerned with the manipulation of symbols rather than the manipulation of objects (Eddie & David, 2001). It is in indeed interconnected concepts, closely-knit structure in which ideas are interrelated. This is to say that Mathematics is hierarchical organized in the sense that lower-level concepts serve as necessary and sufficient condition for the understanding and mastering of the higher-level concepts or otherwise. The beauty of Mathematics is well appreciated when students, who discover some of the structures of mathematics, could locate the interrelationship of one or two concepts in arriving at plausible conclusion without guess work (Patel & Vallabh, 2001). Students take note the lack of contradiction, and see how new techniques are derived from one that has already been learnt, which in turn forms the basis of knowledge concretization.

Teaching of mathematics is not only concerned with the computational know-how of the subject but it is also concerned with the selection of the mathematical contents and communication which afford the learner its understanding and application in line with its objectives (Kulbir, 2008). When teaching mathematics prospective teacher should arm with diverse teaching methods, strategies and pedagogic resources that could be productive and be much more fruitful in gaining adequate responses from the students (Patel, 2001). This should always be done religiously in line with its diverse obtainable objectives as stipulated in the curriculum at each level of educational system (Richard & Jack, 2002). These, according to Olaoye (2008), are:

- (a) *Lower level of Universal Basic Education (Primary)*
  - (i) *Providing child necessary basic skills in numeric*
  - (ii) *Making child to apply these skills to his problem*
  - (iii) *Providing child basic manipulative skills useful in ordinary life*





- (iv) *Providing child basic skills in logical thinking*
- (v) *Introducing child to concepts of spatial relationship*
- (vi) *Introducing child to basic of record keeping and aspects of accounting*
- (b) *Upper level of Universal Basic Education (Junior Secondary)*
  - (i) *To generate interest in mathematics among the students*
  - (ii) *To provide a solid foundation for everyday living*
  - (iii) *To computational skills in the learners*
  - (iv) *To foster the desire and ability to be accurate to a degree relevant to the problem at hand*
  - (v) *To develop precise and logical thinking both in real and abstract situation*
- (c) *Senior Secondary School level*
  - (i) *To develop ability to recognise problems and to solve them with related Mathematical education*
  - (ii) *To provide necessary background for further education in mathematics*
  - (iii) *To stimulate and encourage creativity*
  - (iv) *To observe that each objective has a definite place within the context of mathematical education*
  - (v) *To ensure the translation of stated objectives in mathematics into learning goal*

The teaching and learning of mathematics involve some complex activities and many factors determine the success as well as the realization of its diverse obtainable objectives. Infact, the nature and quality of instructional material, the presentation of contents, the pedagogic skills of the teacher, the learning environment, the motivation of the students are all important salient issues that must be kept in view in an effort to ensure quality teaching-learning of mathematics (Patel, 2001).

In the past, teaching Mathematics objectively was limited to having students' memorized facts and obtained skill in manipulating and calculating numbers. Memorizing of rules and





mechanical manipulation of numbers were considered sufficient. Today emphasize skill in compilation as well as skill in mastery of ideas and understanding of operations are more germane to the teaching and learning Mathematics, and this is why the study sought to find out the unique of mathematics and its diverse attainable objectives in the school system. As a result, the under-listed research questions were raised towards actualization of the main thrust of the study. These include: Why must the students learn mathematics? Why is Mathematics unique? How well equipped are teachers visa-avis objectives, contents and pedagogical knowledge? How do teachers explicitly and deliberately model the mathematics language to meet the objectives? How far have we achieved the diverse mathematics objectives?

### **Statement of the problem**

The study was carried out to ascertain the extent by which mathematics teachers ensure that mathematics teaching attained its diverse objectives in the school system. In order to ascertain this, five research questions were raised for the study as follows:

### **Research Questions**

RQ<sub>1</sub>: Why must the students learn mathematics?

RQ<sub>2</sub>: Why is Mathematics unique?

RQ<sub>3</sub>: How well equipped are teachers visa-avis objectives, contents and pedagogical knowledge?

RQ<sub>4</sub>: How do teachers explicitly and deliberately model the mathematics language to meet the objectives?

RQ<sub>5</sub>: How far have teachers achieved the diverse mathematics objectives?

### **Methodology**

As a survey study where students and teachers were observed during mathematics class fifteen teachers were purposively involved in the study out of which five from primary six, five from JSS 3 and five teachers from SS3. Selection of teachers was based on premise that these classes constituted important classes of the Universal Basic Education. Classroom interaction was observed for six weeks which afforded the study the opportunity to look into teachers' notes of lesson, how these teachers' choices of instructional objectives selected for



each lesson, the chosen instructional objectives carried out and achieved, the instructional language and methods/strategies of teaching adopted by these teachers, the mathematical tasks administered and selected to evaluate students achievement. This was to ensure the uniqueness of mathematics among all subjects in the school system coupled with the need to find out if the teachers and students activities were geared towards achieving the diverse attainable objectives of mathematics as entrenched in the curriculum.

### **Findings**

Sequel to the interaction and observations made in the course of teaching among the students and teachers of mathematics used in the study, reports stated below tries to seek information retrieved to answer the stated research questions:

#### **RQ<sub>1</sub>: Why must the students learn mathematics?**

Each subject in the school system has its role to acquaint the students' necessary skills in order to become a knowledgeable and functional member of a larger society. As a result of contemporary technological advancement for the survival of human existence, Mathematics is an indispensable language towards the understanding of science, which is a prerequisite tool for the Technology. This is why every nation makes it a premium and allows its frequency relative to other subjects in the school time-table even though some students might not appreciate due to some inhibiting factors being envisage at the moment. This, however, call for the concerted efforts of the mathematics to blend the classroom interaction vis-à-vis the teaching of the subject towards the attainable of its intended objectives in the school system. It was observed during an interaction with the 15 mathematics teachers that only 2 were familiar with expected and attainable mathematics objectives. When mathematics teachers are not aware of the rationale for the teaching of the subject one is needed to be informed of the likely consequence on the part of the students in the long run. This is to corroborate the study of Matthew, Dale & Carolyn (2005) that the level of familiarity of teachers' objectives of teaching a subject enhances students' performances since teachers are more consistent sequence, align with curriculum alignment, and evaluate appropriately for that objectives. Apart from this, it was observed that majority of mathematics teachers could not differentiate the objectives of teaching mathematics along with the content areas that they were entrusted to teach. In most cases their mind were narrowed down to teach and pass the anticipated examination in the subject. That was why Basha (2007) pointed out that



mathematics is about solving problems which sustains human existence. Such existence premise on basic requirements like foods, accomplishments, etc, which objectives of teaching mathematics emphasized.

#### **RQ<sub>2</sub>: Why is Mathematics unique?**

The uniqueness in mathematics could be found in the daily application of the knowledge acquired in the subject, which majority seem not to appreciate due to examination orientation in the school system. Everybody uses mathematics whether one realizes it or not. Shoppers use mathematics to calculate change, tax and sales prices. Cooks use mathematics to modify the amount a recipe makes. Vacationers use mathematics to find time of arrivals and departures to plan trips. Homeowners use mathematics to determine the cost of materials when in the course of projects implementation. As a result of indispensable position of mathematics in all aspects of man lives, therefore, there is a need to improve its teaching and teach (Howard, 1956).

First, mathematics teachers need to identify the subject matter they want to present to students, decide how to organize information, specify what to include, how to sequence it, and pin down exact explanations to make it clear. Presenting the subject matter constitutes one of the things which an effective teacher does with other three tracks going on simultaneously. In addition to teaching the lesson, simultaneously, effective teacher manages the classroom towards enhancing students' achievement. According to Avi et al (2002) managing the classroom includes not only the discipline but all procedures that support the lesson, such as pacing the lesson and directions, which ensures students' achievement. This allows the teacher to find out if the students master the subject matter.

However, study showed that most the interaction within the classroom did not allow the great uniqueness of mathematics relatively to other school subject because teachers could substantiate the taught topics to definite task for which the students to appreciate their interrelationship.

#### **RQ<sub>3</sub>: How well equipped are teachers visa-avis objectives, contents and pedagogical knowledge?**

The tenet of objectives is directly related to students' achievement. Lesson's objective is as important as delivery the lesson itself. An effective lesson begins with the introduction,

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during which the teacher states the objective. This describes what teacher is going to teach. Often teachers do this by simply say, for example, "The topic for today is slope." And when such statement is made, students have not been given any clue as to what they ought to know until the end of the lesson. This is only asking the students to memorize the definition of slope, as against making the students to analyze which of various methods of computing slope is appropriate under certain conditions. The type of cognitive function which students do for each of these tasks is dramatically different. By stating the objective clearly and specifically, teacher provides way for students to get ready for the lesson and benefit from it. According to Bloom (1956), designed a taxonomy of cognitive tasks identifies and orders the levels of cognitive functioning. By using the taxonomy in writing the objective, teacher specifies for students the cognitive level at which they function to achieve the lesson objective. As a brief illustration of these, Taxonomy of Cognitive Levels (in order of increasing complexity) range from Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.

After the selection of the cognitive level, the teacher formulates the statement of the objective, in which the following template identifies the key parts: "The students should be able to" *This statement indicates that the students must be successful for the objective to be achieved.* Other Taxonomy includes recall, explain, apply, compare, create, assess.

This verb identifies for the teacher and students the level of cognitive functioning required while the action verb examples which include stating, writing, calculating, performing, and composing, identifies the observable behaviour that the students perform to ensure that they have achieved the objective. Observed situation in the classroom teaching revealed that 88% of the observed teachers unintentionally did not select methods or strategies that could ensure deeper levels of understanding of mathematical concepts and ideas. Apart from this, it was observed that students' learning styles was not acknowledged through the development of strategies that compensate for their individual difficulties in the learning processing. In contrast to the literature that language of instruction plays an important factor in the level of interaction and subsequent to what learning sessions could afford learners. Apart, the interaction with the mathematics teachers revealed that out of the 15 teachers interviewed only 2 of them is familiar with the mathematics objectives. 87% of these teachers were not familiar with the objectives of mathematics as entrenched in the Nigeria Curriculum. Having familiar with the objectives, the teachers were more likely to teach via objectives and then



evaluate for the objective (Matthew, Dale & Carolyn 2005). Students are most successful when their teacher uses this consistent sequence, known as curriculum alignment.

**RQ4: How do teachers explicitly and deliberately models the mathematics language to meet the objectives?**

The goal of evaluation is to determine where both written and verbal languages occur to predict any mathematical breakdowns. Studies have found that knowing whether a dyslexic child struggles with things like word retrieval, memory, sensory integration, sequencing, and processing speed provide teachers with helpful clues about the child's potential and challenges in mathematics (Christine, 2005; Kathryn, 2007; Peter, 2009). It was observed that *the methods used were not in any way* explicitly and deliberately models the mathematics language to meet the objectives. Most teachers taught in anticipation of the prescribed examination that students were expected to do in future. Traditionally, methods of teaching mathematics include conventional approach, classical education, rote learning, exercises, problem solving, new mathematics, heuristic method, standards-based mathematics, relational approach, recreational mathematics among other methods; and teaching strategy is refer to "a plan that not only specifies the sequence of needed actions but also consists of critical guidelines and rules to making effective decisions during a problem solving process" (Deshler, Ellis & Lenz, 1996). These include involvement, analogies, analysis, rule, definition, modified experiment, translation, examples, models, games and simulation, discovery and cooperative teaching. Teachers that were observed neither put any of the aforementioned into use nor emphasized their needs to bring out the objectives of teaching the subject. Assuming there were application of some these methods and strategies during classroom interaction there would have been great impact on performances of students.

**RQ5: How far have teachers achieved the diverse mathematics objectives?**

In a survey carried out to actualize the raised research question five, diverse responses were obtained as indented below:

*'Mathematics is important and useful in our daily life',  
'Mathematics is the basics for other subjects such as social  
sciences, sciences and engineering', "Mathematics helps  
to develop logical thinking" "Mathematics helps to find the*



*right way to solve problems". "I love mathematics, so I would like to help my students appreciate the subject."*

Each of these answers suggests a reason for the importance of school mathematics in the teachers' mind. Nevertheless, each answer is only a partial answer to the question. So what about mathematics? The answer was not so apparent. Much has not been done as good job of identifying what mathematical thinking is and why it is valuable. Mathematics has been something one just learns to do. Some in the class pointed to computer programming and the need to work in different number systems like binary and hexadecimal. True enough that the understanding of base 10, base 2, and base 16 have vocational value, but what if one does not want to be a computer programmer?

There is a possibility that different teachers may have varieties of answers to the same question but the overall responses showed earlier stated ones.

Meanwhile, finding showed that teaching and learning of mathematics is imparted for achieving certain goals and objectives. Although various subjects of the school curriculum have different means to achieve these goals, and this is synonymous to the assertion of Peterson, et al (1992). Although various subjects in the school curriculum have different means to achieve these goals. Sidhu (1995) pointed out the goals of teaching mathematics are as below:

*To develop the mathematical skills like speed, accuracy, neatness, brevity, estimation, etc. To develop logical thinking, reasoning power, analytical thinking, and critical-thinking, To develop power of decision-making, To develop the technique of problem solving, To recognize the adequacy or inadequacy of given data in relation to any problem, To develop scientific attitude i.e. to estimate, find and verify results, To develop ability to analyze, to draw inferences and to generalize from the collected data and evidences, To develop heuristic attitude and to discover solutions and proofs with the own independent efforts, To develop mathematical perspective and outlook for observing the realm of nature and society.*





### **Implications of the findings**

If mathematics teachers are not aware of these objectives, what mathematical tasks are they going to evaluate the students on? In a nutshell, the mathematics tasks that learners work on during lessons play a role in what they learn and what they learn is an integral part of the uniqueness of mathematics and also a subset of the diverse attainable objectives of mathematics. Apart from this, the relationship between school mathematics and that of mathematics out of school work can not be overemphasized. This provides a strong base for the relevance of the knowledge of mathematics to everyday activities. Like reading, mathematics involves many cognitive processes or systems. Ideally, teachers should diagnose and treat mathematics breakdowns with the same specificity and strategies they apply to language-based instruction. When mathematics remediation is most effective and efficient, it employs the same best practices that are used to address reading struggles. It should be emphasized that using hand motions when teaching songs or poems is helpful since it provides cues and context clues that reinforce learning of the content. Likewise, the best mathematics instruction utilizes student strengths to mitigate weaknesses, and use context and the integration of multi-sensory techniques to help the student make meaning and improve memory.

### **Discussions**

Research has shown that teaching in ways that support learners to become mathematically proficient is very challenging for many teachers. So, professional supports in relation to specific teaching practices, for example in generating and sustaining learners' interaction, may be necessary to improve teaching effectiveness, as well as improve learners' achievement and their level of mathematical reasoning and proficiency. Such support could be as simple as dropping a hint on practices that could be adopted to sustain learners' interaction such as allowing use of languages of choice.

Monitory teams should endeavour to monitor the teachers' lesson notes and the subject note of the students to ensure effective service delivery. For instance, about 87% of these teachers are not familiar with the objectives of mathematics as entrenched in the Nigeria curriculum. Having been familiar with the objectives and the stated objectives, the teachers are more



likely to teach to that objectives and then evaluate for that objective (Matthew, Dale & Carolyn 2005). Students are most successful when their teacher uses this consistent sequence known as curriculum alignment as who do not appreciate mathematics are those who do not understand what mathematics is all about. That is why the nature of mathematics desperately needs to be explained. Simply put, mathematics is about solving problems. Ever since there were humans in existence, then there would be problems to solve. Assuming the problems were that of basic requirements like sustaining sufficient amounts of food or major accomplishments like constructing multifunctional homes, problems such as these remain with us to this day, yet the peculiar thing about problems is that they all have similar properties. Successful problem solvers are able to understand what is expected of the problems that they face. In other words, they know all of the details surrounding the problem at hand, and which is the most important step to solve problems. It requires an attention to detail and therefore patience after examining in details, and the intelligent choices need to be made as well as the beginning steps of developing a strategy.

Secondly, the plan must be carried out in an order that makes sense. Careful planning, possibly by justifiable experimentation must take place. Once an actual solution is obtained, it must be tested to determine whether or not it is reasonable. Every mathematics problem that were discussed, handled, and assigned forces one to use many, if not all, of the detailed methods of problem solving. Each individual problem becomes a small but important lesson for solving problems is general. Mathematics is traditionally learned by first doing many smaller problems and the small problems are put together to solve bigger problems. For instance, in order to solve algebraic equations, being knowledgeable about addition, subtraction, multiplication, and division is a must. Ordering the steps to be carried out, evaluating expressions, and learning how and when equations are used must be learned, too (Mark, 2004).

Mathematics reform curricula all over the world emphasize interaction in the mathematics classroom. Various researches carried out supported the view that unless the natural barrier of language, which could hinder meaningful interaction in the classroom, is dismantled, hope of experiencing interaction in our classes might continue to be a mirage. Teaching in ways that support learners to become mathematically proficient is very challenging for many teachers. So, professional supports in relation to specific teaching practices, for example in stimulation/generating and sustaining learners' interaction, be necessary to improve teaching

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effectiveness, as well as improve learners' achievement and their level of mathematical reasoning and proficiency. Such support could be as simple as giving hints on practices that could be adopted to stimulate learners' interaction such as allowing learners use of languages of their choice. This is a challenge for teacher educators and trainers in the African sub-region, and has implications for language policies, if learners are to learn maximally in schools.

Improving upon example, like "The topic for today is algebra," the following objectives would provide essential information for students:

#### Objectives for the Topic of Algebra

Knowledge: recall the definition of quadratic by stating it orally.

Comprehension: explain the definition of quadratic by stating it in his/her words.

Application: apply the formula for quadratic by calculating the roots of given equation, in writing.

Analysis: compare the quadratic of several equations by stating their similarities and differences, in writing.

Synthesis: create a new look for quadratic formula in mathematics by adapting it.

Evaluation: assess the value of the concept of quadratic in word problems leading to quadratic in an essay.

Note that a verb such as "understand" is not suitable. It could not be a taxonomy verb, because it is too vague, and it could not be an action verb, since it is not an observable behaviour. The well-stated objective has additional value in relation to how one learns.

Students must be able to function at the lower cognitive levels before they function at higher levels. Learning on any topic proceeds through the taxonomy levels. Students must have information at the knowledge level - facts - before they perform at any of the higher levels. For example, they could not participate in a discussion on a given topic if they did not first comprehend the facts that bear on the analysis of that topic. Bloom (Op cit) states that as students perform better at the lower levels, their success at the higher levels is more likely. He calls this automatic, "the hands and feet of genius".





Having stated the objective, the teacher is more likely to teach to that objective and then evaluate for that objective. Hence, students are most successful when their teacher uses this consistent sequence, known as curriculum alignment.

### **Recommendations**

It is therefore pertinent that periodic seminars and in service training should be made compulsory for all mathematics teachers irrespective of their educational levels. This would bridge the inadequacies noted during the course of the study. Apart from that, there is urgent need for support teachers under training in terms of teaching practices that focused on improved teaching effectiveness. This is necessary in order to acquit them with the best practices that help them focus on mathematical tasks relevant to the diverse attainable mathematics objectives.

### **Suggestion for further studies**

At different times and in the different cultures and countries, mathematics education has attempted to achieve a variety of different objectives. In contemporary education, mathematics education is the practice of teaching and learning mathematics in order to achieve some specified attainable objectives (Matthew, Dale & Carolyn 2005). Researchers in mathematics education are primarily concerned with the tools, methods and approaches that facilitate practice or the study of practice in line with the society objectives (Anthony 2004). Extensive study could be carried out at higher level of education to authenticate the earlier claim. Apart from this, subjects where students perennial dismal performance are being noticed could also be focussed so as not to waste hard earned public fund in promoting efforts in futility.

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