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Verbs Deploymentin Mathematical Expressions: A Pedagogical Explication

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ABSTRACT

The quest for technological advancement in the technology-driven global order of the contemporary world, to a large extent, drives the educational policy of any developing nation like Nigeria. Hence, in virtually every facet of the country's educational policies, science is accorded a prime placement at the expense of the arts and humanities. It is within this context that mathematics has emerged as a major hurdle which a student must scale for any rewarding schooling career, at least, at the secondary school level.Ironically however, the subject has continued to constitute the archiles heels for many students both at the pre-matriculation and post matriculation examinations.

This paper contends that mathematical language exists in crystallized form which is not readily available to students. There is therefore the urgent need to de-crystallize this language for easier decoding by learners of the subject. It does this by examining the verb contents of such expressions and their strategic placements in them.

The paper thus submits that since verbs are central to message decoding, an insight into the behaviors of verbs in mathematical expressions is the key to unlocking the cryptic occultism that alienates students from the subject.

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1.0 INTRODUCTION

Our education policy in Nigeria today stipulates that for any student to gain admission into any tertiary institution, he or she must compulsorily have a pass, at the credit level, in English and Mathematics with credits in other relevant subjects at the ordinary (i.e. school certificate) level. This requirement has however, denied many prospective undergraduates placements into our universities and other institution of higher learning. Most students find it easy to obtain credit passes in other subjects, but find it difficult to do same either in English or Mathematics or both of them at the same time. Our contention here is that most students find Mathematics difficult, because they find it difficult to understand the language in which mathematical expression are coded. Since the verb is about the most crucial element of a sentence, a careful exploration of verbs deployment in Mathematical expression might just be the key to un-lock the secret in the mathematical riddles for many learners of the subject. Specifically, this paper undertakes an exploration of the possibilities of determining and analyzing the specialized value of verb using one of the most recent methods of lexical analysis .This procedure developed by Patrick Hanks is known as corporate pattern analysis(CPA). It is a procedure that is used to determine the syntactic and semantic patterns of the usage of lexical items in a text.

1.1 Verb placement and function in english expression

Limitless literatures exist on verb and its uses in English, so also are scholarly studies on its use in specific contexts. For example, Metcalfe and Astle (MCMLXXX: 35) see it as "the part of speech which denotes action, or the doing of something".

From this simple definition, the fact emerges that it is the verb that activates a sentence. Thus, the whole essence of any stretch of expression is anchored by the verb, hence, commands, suggestion, guesses, conclusions, recommendation, etc are carried by the verb. In essence, nothing can be done with a string of words bereft of the verb components. Greenbaum and Quirk (2005: 30) view the verb in two senses;

1. "The verb is one of the elements in clause structure, like the subject and the object".
2. "A verb is a member of a word class, like a noun and an adjective"

In the first sense above, the verb occupies a distinct structural box within the syntax of language. If a clause has an SVO structure, the verb explains the relation that exists between the subject (s) and the object (o) components which otherwise stand an independent, unrelated grammatical elements.

Consider the following as examples:

The old man (s) or (o)

A big snake (o) or (s)

These two independent grammatical elements within the clause structure do not have a coherent sense beyond their isolated semantic imports. They only acquire a sense in a syntactic string when the missing slot marshaled by a verb is supplied as we have in;

1. The old man must have killed a big snake or

2. A big snake must have killed the old man.

In these sentences, two facts emerge;

i. The subject and object slots are interchangeable without any syntactic and expressive damage done to the structure of the change.

ii. The verb slot remains fixed as the vital link between the subject and the object. All these underline the importance of the verb in any communication process, be it social, negotiative, or pedagogic setting. Our fact here is to interrogate how verbs are deployed, manipulated and made is behave in mathematical expression. Beyond this, we also intend to investigate what category of verb is manly employed in the mathematical equation to create its cryptic maze. As hinted above,existing scholarship in the use of English in scientific texts bear eloquent testimony to the fact that language is an important tool in the business of scientific procedures. This study is a modest contribution to discourse in this field. For the purpose of this paper, our focus is limited to verbs deployment in the field of mathematics.

The centrality of verb in a sentence or clause is attested to by Mary Tinuoye (1996: 21) in her definition of the sentence an *"a basic unit of a language which has at* ***itscore*** *at least an independent* ***verb*** *which usually has a subject."*(our emphasis). This consideration places the main semantic load of a sentence on the verb which lies at its core. It then means that decoding the message in a sentence implies decoding the verb. Her study covers the aspect of grammatical patterns in scientific English.

Other scholars who have contributed to scholarship in the specialized field of English use include Victoria Alabi (1996) who carried out an examination or parts of speech used as communication tool in medical texts. She came out with the finding that nouns and pronouns, as instrument of naming and adjectives as well as adverbs as descriptive words are used preponderantly in medical texts.MuibiLawal's (1996) study centres on the use of numbers, signs and symbols in medicine, engineering, science, technology, agriculture and arts. He succeeds in shedding some lights on the grammatical patterns in the sings employed in these fields.

From the above, it is clear that despite efforts made at studying specialized used of English in sciences, little attention has been placed on the deployments of verb as a very important part of speech in specific field of science.This paper seeks to bridge this gap by shedding light on how verbs are deployed in the field of mathematical science.

Theoretical framework

Sine this study falls within the ambience of English for special purposes (ESP) we follow the theoretical footprint of Hanks (2004, 2013) who propounds the theory of norms and exploitation (TNE). This theory posits that when words usage conforms toits ordinary dictionary meaning it is viewed to be functioning in its normative application. On the other hand, bidding outside its diurnal use, it is referred to as exploitation. This, simply put, is reference to the creative use of words. According to Compo and Arague (2013:281*),” they are mainly cases of metaphor, metonymy and other creative uses of words, and they can also be related to syntax or combinatory.”* Since verbs behaviour in mathematical expression exhibit some deviations from their normal usages in ordinary prose or conversations, they can be said to fall within the ambits of Exploitation of Flank of Hanks TNE. Though in terms of semantics, the verbs still retain their meaning, in terms of syntax there are some marked deviation from the normative slots which they occupy in the traditional sentential structures of English. To detect such specialized functioning, we complement TNE with corpus pattern analysis (CPA). This work therefore focuses on a methodology for the detection of specialized uses of verbs that starts form Corpus Pattern Analysis (CPA). This analysis is meant to show a procedure for combining syntax and semantics uses in describing lexical meaning context.

In this study, Corpus Pattern Analysis (henceforth (CPA) is adopted as a mechanism to understand the meaning or meanings of verb in phraseological context in which it is used. CPA, according to Hanks (2002) is "*a new technique for mapping meaning onto use*." Going by this, verbs in mathematical equations are examined within the prism of algebraic dictation of mathematic science.

Relying on the above-mentioned theoretical instruments, we shall proceed to examine how verbal elements are encoded in mathematical signs and symbols, their placements within the syntax of mathematical phraseologies, their peculiar meanings (if any) within those context and how they are deployed within the logical sequence of calculation steps of mathematical procedures. With these, it is hoped that the inner crannies of those formulas will further be illuminated for pedagogical enhancement of the subject. Examples are taken from such mathematical topics as surds and quadratic equation which constitute the basic knowledge in the mathematical science.

Structural patterns in mathematical sentences

Almost invariably, mathematical problems/equations are crafted with the verbal element occupying the initiating syntactic sentential position, subject having been implied from the structure.

We now have something like;

i. **Simplify** $\sqrt{45}$, $\sqrt{x^2y}$, $3\sqrt{50}$ (P. 1)

ii. **Express** $2\sqrt{3}$ on the square root of a single number (P. 2)

iii. **Rationaliz**e the denominators of $\frac{6}{\sqrt{3}}$ (P. 3)

iv. **Evaluate** $\frac{\sqrt{8}}{\sqrt{50} - \sqrt{2}}$ (P. 7)

v. **Solve** the equation $2x^2 + 9x = 5$

The syntactic structures of the above are as follows:

i. V O,

ii. V, O, A

iii. V, O

iv. V. O

v. V. O

The functional sentence type here is commands/imperatives where the subjects is clipped off making the verbs to begin the clause as a way of foregrounding the task required of the student/learner.

Example: Simplify (a) $\sqrt{45}$. (b) $\sqrt{x^2 y}$. (c) $\sqrt{50}$. On the surface of it, apart from the initiating command expressed by the verb, "*simplify*", the rest of the expression in almost meaningless expect for the recognition of the figures and letters employed in them. We are then forced to inquire;whatare the hiding expressions in those equations?. Put in a clearer language, how does one begins to simplify a message whose idioms are coded in enigmatic signs and symbols? For our purpose here, how do we render the above equations in prose forms and what role does the verb elements play in de-ambiguatingan otherwise inaccessible conclave of figures and symbols.

The starting point is unraveling what the symbols mean and how are they conveyors of meaning in a mathematical set-up.

To simplify the equation; $\sqrt{45}$ therefore means………………..

i. ***Find*** the square root of 45

ii. ***Find*** the number whose square is equal to 45

iii. ***Is*** there a number when ***multiplied*** by itself that***will give*** us 45?

Apart from the initiating verbs, "*simplify*", '*find*', '*write*' and '*is,*' there are other verbs encoded in the sign; $\sqrt{\square}$. This sign is known in mathematics as '*square root'* which is interpreted as we have demonstrated above, i.e. it is a sign which encapsulates the clime ofverbs that dictates the task that must be carried out. This interpretation falls within the exploitation aspect of TNE prescription because, in ordinary consideration, the '*sign*' $\sqrt{\square}$ cannot be considered as a verb except within circle or mathematicians that see and understand it as such.

Note: also that these verbs are the main carriers of the instructions that the learner is expected to carry out. Without the inclusion of those verbs, the expression are rendered meaningless. What we are saying here in essence is that mathematical signs and formulas, though have meanings of their own, they still require verbs or verbal elements to make senses. For example, the word, '*boy*' has a referent in English, but the meaning does not go beyond that without the accompanying verb element like "*plays,*" to give us a statement like "*boy plays.*"

Beyond the confines of the verbs that are clearly stated, some are expressed through the instrumentality of the mathematical signs in different contexts. Without a proper appreciation and understanding of them as such, it might be problematic for the learners of mathematics.

Consider the following examples as contained in the equation above:

1. 2x means 2 multiplied by x or the other way round i.e. x multiplied by 2
2. x^2 also means x multiplied by x in essence, to multiply is representable by 2x or x^2
3. The same principle is noticed in the division equation as we have in $(8 \div 2)$ or $\frac{8}{2}$. These are in interpreted as 8 divided by 2.

From these examples, the verb plays a leading role in decoding the message of the equations

The centrality of the verb in decoding the messages in isolated mathematical expressions also holds true for the procedures involved in solving the puzzles in its algebraic jigsaws. Every step

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must contain a verb pointing in the direction of the final solution. Note the following for example;

Problem: solve the equation $2x^2 + 9x = 5$.

Interpretations:

i. What is the numerical value of x for which the solution of the equation above is 5? Or

ii. What is the numerical value of x such that if we multiply these values by 2 and add it to the value multiplied by 9 will give us 5?

Stepwise solution:

The steps in mathematical procedures are coherent and logical statement in which preceding verbs smoothly flow into those succeeding them. Without these verbs, the logics fall asunder and they are rendered meaningless to the learners of the subject. Let us consider the steps involved in solving the above (i.e.$2x^2 + 9 = 5$)

Step 1: Subtract 5 from both sides of the equation i.e.

$$\frac{\frac{\square}{2x^2} + 9x + 5}{side\ A} = \frac{\frac{\square}{5} - \frac{5}{\square}}{side\ B}\ m ==> \qquad \mathbf{2x^2 + 9x - 5 = 0}$$

Step 2: find the product of the first and the third terms of the equation i.e. $2x^2$ x -5

Step 3: find two numbers whose product will give us the co-efficient of x^2 in step 2 above (i.e. – 10 and whose sum will produce co-efficient of x in step 1 above (i.e. 9). This is mathematically expressed as $2x^2 – x + 10x – 5 = 0$

Considering the sentence structure of the three steeps enumerated above, we have? +V +O, where? Strands for the elipted subject element. The reason for this is not far to seek; mathematical statement have little or no time for the explicit of SVO structure. The mathematician therefore foregrounds the verb elements by bringing it to the initializing position of the sentence. This then puts the semantic load of the entire clause on the verb. What this means is that the learner of mathematics must pay special attention to this grammatical elements and decode all its possible interpretations within the context of the mathematical expression and the task that the equations require.

Another basic but critical area in mathematical studies is the aspect that mathematician refer to as surds. As shown in the other aspects of mathematics discussed above, verbs also play crucial roles in solving equations here.

Let us consider the following example:

Simplify $\sqrt{27}\sqrt{50}$

The verb '*simplify*' also means, in this expression reduce the product of square root of 27 and 50 to their lowest forms or their fundamental parts i.e. their lowest common multiples. The ability to correctly decode this verb as we have done here automatically leads the learner to the steps to follow

Steps

Step 1: Reduce 27 & 50 to their basic common multiples i.e. what are the numbers whose basic multiples will give us 27 and 50 respectively? This could be interpreted thus

27 = 3 x 3 x 3

50 = 5 x 5 x 2

Step 2: Bring together the like terms in the multiples identified in step 1 and convert them to the possible square roots.

i.e. $\sqrt{3^2} \;\; x \;\; \sqrt{3} \;\; = \;\; \sqrt{27} \;\;\; and \;\; \sqrt{5^2} \; x \; \sqrt{2} \;\; = \;\; \sqrt{50}$

Step 3: Bring the like terms of the square root together

i.e. $\sqrt{3^2 \; x \; 5^2} \; X \;\; \sqrt{3 \; x \; 2}$

Step 4: In the equation above the square root cancels out the root represented by the sign (√) thus we have

3 x 5 $\sqrt{3 \; x \; 2}$

= 15$\sqrt{6}$

All the foregoing analysis revel that verbs play central role in mathematical pedagogy. It is used as the main carrier of the task to be performed, the steps to be taken and the sequencing of the logic in every step to achieve a cohesive whole.

In conclusion, just like in normal interactions, verbs is mathematical expressions are the major carriers of the message. They exhibit flexible behaviors in terms of meaning within the specialized mathematical dialect of English language where for example a verb like '*simplify*' must include within the ambience of their semantics such other verbs like '*solve*', '*find*', '*behave*' etc. lt is also discovered that most verbs employed here belong to the open ended lexical verbal class where such meaning of tense, numbers and person are largely unspecified. Also the verbs largely of the transitive category where the receiving objects are equation. It is therefore important for the students of mathematics to understand the verbs behaviors in these subjects as this will prove an invaluable assets towards removing some of the famed occultic marks that alienate the learners from the big masquerade which the subject has proved to be over the years.

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