Igbo Numerical System and Mathematics: Towards Harnessing Potential for Business, Governance, Science and Technology

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Abstract

This study explored the nature of Igbo numerical system and mathematics towards harnessing its potential for business, governance and science and technology. Like other civilizations, Igbo mathematics evolved from its numerical system which is aboriginally vegesimal number system (of base 20). The Igbo number system was advanced because it has number names for all the numbers within its vegesimal system although the numerals were not symbolized. Outside its general and conventional use, the Igbo numbers do have social and religious implied meaning which influenced the use of the numbers and the people. The cultural influence of this number system to a large extent determined the utility and application of same in mathematical principles and later in its outcome as human development. Some humanistic aspects were implicated such as business enterprise, governance and science and technology as areas where the application potentials of indigenous numerical system and mathematical expressions in daily usage and science can be harnessed for greater benefits.

Key words: Ibo mathematics; Ethno-mathematics; Traditional Igbo number system; Governance; Science and technology

INTRODUCTION

Mathematical science is only possible because of the evolution of numeric application. Mathematical concepts tied to numeric applications which are dependent on the counting systems as they exist in any cultural context. The counting system of every culture is the foundation of its number systems. Ogoamaka (2013) emphasized that the formulation and development of any number system constitutes one of the most important bedrocks of mathematics, science and technology; this, in the thoughts of the researcher could also be extended to advancement of business ethics and governance. This could be achieved as much as the principles and properties are applicable. Wilder's (1973) evolution of mathematics contended that rules, principles and properties which govern the formulation and the existence numbers (includes names given to the numbers) critically emanate from the cultural perception of the people who use them. This cultural perception of numbers and numeral in terms of quantity, the order, the position, ratio etc could also influence its uses both culturally and globally.

No human society (including that of the Igbos) evolved without a distinct number system which enabled them to infer quantity, position, order, depth etc, although; at their evolution not all cultures have numerals (usually figures or symbols) which represented distinct units of their number system. Perhaps the lack of numerals in most established number systems of the world could be ascribed to non existence of writing in those cultures which consequently necessitated objects (counting tallies) to be used to record number values like in transactions. In many cultures of the world, the human body (parts of the

body) has been deployed as symbols of figures depicting numerals. This may be the reason why many cultures of the world have their number system in base 10 (decimal rather than vegesimal) which corresponds to the ten fingers or the ten toes. However, this evolution supported more of the vegesimal base which combined the fingers and the toes as the basic base.

The Igbo people of South-Eastern Nigeria although did not invent symbols for their number system do have a defined numerals which many authors agree contains fiftteen distinct units which include: otu (one), abuo (two), ato (three), ano (four), ise (five), isii (six), asaa (seven), asato (eight), itolu (iteghete) (nine), iri (ten), ogu (twenty), nnu (four hundred), puku (one thousand), nde (one million) and ijeri (one billion). These units were deployed in the development of native mathematical principles and logics in the everyday life of the Igbos. The Igbos used a mathematics system known as Okwe and Mkpisi which has similar principles to those of addition, subtraction, multiplication, division etc. Counting devices include tokens and counting boards and usually coexist with other ways of representing numbers in Igbo language.

The Okwe and Mkpisi mathematical system contained expressions referring to: one-to-one correspondence, base, place value, order of magnitude etc. Although, the traditional enrichment of may be said to have been lost due to the contact with Western mathematical principles which were largely decimal however, it is believed by the researcher that the original principle of Okwe and Mkpisi could be harnessed for business, governance, science and technological advantages.

REVIEW OF LITERATURE

Ethno-Mathematics

Abonyi (2015) sees ethno-mathematics as the science of numbers and its manipulations that are embedded in the people's culture. Ozofor and Onos (2018) contended that it is cultural perception and understanding of reality and mater that enabled her citizens defined and name numbers in terms of their values. The number manipulations are based on cultural numeric systems applicable in their daily living such as its use in cultural artifacts like: mats, clay pots, clay bed, houses (round and rectangular), decorations, baskets, local drums and fish traps. In mathematical teaching approach, it makes the learning of mathematics very meaningful. Ethno-mathematics is also the mathematics used by a defined, peculiar or specified cultural group in the course of dealing with environmental problems and activities (Kurumeh, 2006). Many have emphasized that the gap between the indigenous mathematics and eurocentric mathematics (present classroom mathematics) may have affected in tangible way other walks of life such as: business, governance and technological advancement (Enukona, 2002).

Igbo number system and Igbo mathematical Science

The existence of number names in the Igbo aboriginal language and culture is evidence that the Igbos have a numeric and mathematical system which is rich and advanced like most other civilized cultures of the West. The typical number system (although not with numeric symbols) of the Igbo was completed long before her contact with colonialists. Originally, the Igbo number system is vegesimal rather than decimal but it could be said that the dominating pressures of west influenced the adoption of the decimal number system through the Igboland such that for example, twenty which is "ogu" (original vegesimal number system) is now represented in its decimal format as "iri abuo". This circumstance has reconstructed the Igbo number system to the present day base 10 or decimal system. For instance, Ogoamaka (2006) contended that the traditional Igbo number system has such basic number names as Otu, Abuo, Iri, Ogu, Nnu, (20_2), Puku, (20_3), Nde, $(20_4$ & $20_5)$ Nnu nde/Ijeri, (20_6) which expresses that its unit is vegesimal hence; 'Nari'(100) is of a western decimal influence and not a typical traditional Igbo number system and "Puku" actually means 8000 (Ogu nnu) rather than 1000 whereas "nnukwuru nnu" means "ogu puku" 160,000.

The Igbo number system and mathematics has rules and principles that governed the formulation of non-basic number names which are rooted as vegesimal number system although, the contact with the West corrupted it leading decimalized system for example the numeral "puku" means 8000 in the original vegesimal system instead of 1000 in the current decimal system. Thus in forming number names the traditional Igbo number system employed one, two or three of the additive multiplicative and subtractive rules (Ogoamaka, 2005).

Additive (mgbako), subtractive (nwepu) and multiplicative (mgbakwunye) principles were based on the vegesimal counting system for example:

Mgbako = Ato na otu (3+1) = ano (four)

Iri na ise (10+5) = iri n'ise (fifteen)

Ogu na iri na asaa (20+10+7) = ogu n'iri n'asaa (thirty-seven)

Ogu abuo na abuo (40+2) = ogu abuo n'abuo (forty two)

Nwepu = Bere ato na iri (10-3) = asaa (seven)

Bere otu na nnu (400-1) = ogu iri ise n'ogu iteghete n'iteghete (three hundred and ninety-nine)

Bere ise na ogu isii (120-5) = ogu ise n'iri n'ise (hundred and fifteen)

Mgbakwunye = Ogu ano (20x4) = 80

Nnu ise (400x5) = 2000

Puku ato (800x3) = 24,000

From the above mathematical expressions, the vegesimal number system was implicated as the base of

Igbo mathematical science.

Furthermore, according to Ogoamaka (2006) the Igbo number system before its contact with the West had names for fraction and other mathematical representation such as mpekele which means fraction; "okara" which means half; otu na uzo ise (ratio). These also show that the traditional Igbo numerical system as it was then was advanced. However, since the number system defines the mathematical culture of any given society, it therefore follows that the attributes of the Igbo numbers in divergent appreciation influenced their use in mathematical principles.

For the Igbos, names of numbers and values they represent have many connotations: general, everyday or common place usage and humanistic (social and religious interpretation). General usage of numbers for everyday life more or less involve the quantitative meaning of the number either in the cardinal or ordinal sense whereas social and religious uses and interpretation of numbers ascribe social and religious meaning to the numbers other than their quantitative values. The traditional Igbo person sees and appreciates certain numbers as though they are totem or possesses some powers or individualities or as though they are agents of gods or gods' representatives for example, "ato" (three) and "asaa" (seven). Generally the traditional Igbo person sees even numbers as being more 'amicable' or acceptable than odd numbers are as omens and with respect to the cardinality of items or objects used in gifts. The story or myth about the Gorilla's obsession for pairing objects (abuo na abuo) available to it, that comes its way to stress and teach the desirability of using even numbering objects for gifts. The Igbo people may have been made to take the above decision or accept such an attitude, belief or rule because it coincides with the fact that most parts of the body or organs of a normal person are in pairs! So, for the Igbo the number system are not just arrangements or rules of numbers, they also have religious implied meaning which emanate from the socio-cultural beliefs of the Igbos which govern their everyday life.

Igbo Mathematics and Application to Critical Aspects of Human Development

To appreciate the role which Igbo mathematics may offer to human development, it is pertinent to consider the contrast between western mathematical ideology and that of traditional Igbos. The West appreciates mathematics is a science whose subject matter is special forms and quantitative relationships of the real world. It is also seen as the science which draws necessary conclusion from logical evidence of fact demonstrated with the aid of numeric system. However, for the traditional Igbos, the number systems have both common connotation and implied religious/spiritual meaning. For example three (3) and four (4) represents balance because three (3) is synonymous with ikenga and four, the four (4) market days whereas seven (7) connotes spiritual perfection.

Therefore from mathematical problems related to these numbers, it could be inferred that special note is taken regarding their re-occurring forms and multiples.

Along the implied cum religious meaning imbued in the Igbo number system, there is a belief that this numeric application will influence the mathematical principles of the Igbos and have a psychological influence on the way in which people live their lives I relation to understanding nature and their environment especially as regards its potential for business, governance, science and technology.

Business Enterprise

Without the science of numbers, business transactions will suffer a terrible blow. Although the Igbo mathematical principles internalized the system of transactions in terms of additions, subtraction, division and multiplication to be like the western decimal system, there is huge potential that the vegesimal number system of the Igbos should have created a simpler and faster mathematical models considering that the Igbo mathematics have fewer numerals which will make calculations and other number expression shorter, faster and easier and at the same time containing more values within. For example, consider that in the vegesimal base the numeral "puku" is 8000 (400x20) whereas same in decimal is It should be appreciated that the traditional business world of the Igbo reflects in its abstract nature these vegesimal numbers system which also have applicable rules of today's addition, multiplication and subtraction principles like the West. For instance, Ninan, Abimbola, Elesemoyo, and Obasa (2017) found that computational analysis of Igbo numerals in a number-to-text conversion system was able to generate correct and accurate representations for Arabic numbers from 1-1000 in Igbo language showing the extent of influence of the Western decimal assimilation. These computational basics hold lots of potential if harvested.

Governance

Mathematical application holds potential solution for abysmal leadership crises in our society like in determining leaders based on peoples' consensus. Consensus is application of the law of average and modal selection typical of the any voting system. Voting theory which is purely mathematical means of deciding acceptance, competence and desirability of a candidate to an office is clearly related to deploying mathematical models to provide solutions to social issues and there is no optimal solution for problems. Although, there is no perfect voting system but fair play, transparency and credibility can make the voting system better approach to leadership crises. Typically, the Igbos' problem of lack central government or united leaders can also be solved using mathematical approach to the issues by applying the law of average to arrive at decision of leadership and cause of action beneficial to the Igbos.

Apart from the application of law of average and modal selection of leaders, mathematical ideologies is yet to be groomed in the resource allocation and distribution of amenities both communally and nationally. Laws of mathematical ratio are very promising regarding resource allocation and management which is typical application of mathematical laws. The current cries of marginalization can be ameliorated if the ratio of population, natural resource and distribution of end resources were aggregated.

Science and Technology

No doubt, mathematical principles can still influence indigenous technologies to a greater height because mathematics is the language of Science, Technology and Engineering. Science and technology is intertwined with mathematics even in its remotest sense. Like in the modern times, adoption of mathematical methods in the social, medical and physical sciences in most of the cultural heritage of the Igbos will expand the horizon. For example, the potential of native breakthroughs in the field of medical and physical sciences can be expanded rapidly if mathematical principles are applied. For example, much of potent native medicines are not exportable because there are no clinical trials on their usage. Clinical trial is nothing but an application of mathematics in confirming quantity, quality, usage duration and reactions. Applying mathematical principle in getting the right dosage and documenting same for comparison of will enable indigenous Igbo breakthroughs in medical field to be recognized and thus acceptable. Again, there are many other areas of the traditional science and technological which are yet to be quantified mathematically in order to have a hope of replicating them. In this respect, many African sciences are dubbed "magic" because like other scientific applications there are no mathematical models or representation which supports their validity. Hence, most of these innovations are brandied fetish and magical without proof on any side of the argument. Mathematics being an integral part of science and technological requires local content in understanding the elements which are deducted and imploded in order to adhere to the principles of parsimony and repeatability. This is one aspect that is lacking in indigenous science and technology.

DISCUSSION

Evolutions of science and art have common ethno-geographical influences, which has its roots in cultural appreciation of unique language of the people and their number system. Science and arts are richly embedded in ethno culture and are express through the use of language and through the number system. Therefore there is an understanding that to maximize the potential of any culture for business, governance, science and technology, there is need to understand and appreciate the language and numerical system of such people which contains rich

material and immaterial substance for the advancement of science and arts. Such appreciation for instance in the Igbo language and vegsimal number system, are unique and consistent with the penetration of her values in all walks of life especially in the use of numbers in her native governance and administration, business enterprise and understanding of the underlying factors of science and technology.

Culturally and otherwise, the study is offers evidence that the Igbo number system which gave birth to her number system contain basic assumptions of mathematical science which draws necessary conclusion from logical evidence of fact demonstrated both in abstract and application. Like odd and even sequence, balance as number three representing a native tripod (ikenga), seven perfection and one unity and wholeness with zero being an "efu" state of nothingness. The richness of these numerical appreciations are embedded and appreciated in the use of numerical codes and assignment of numbers to things and events. In these situations, the cultural differences are likely to align it for a misconception and hence reduce the appreciation in all its applicable circumstances. The disadvantage is that the usurpation of perceived lower ethno numerical system by perceived superior ethno numerical hat has forced many valuable of aspects any numerical systems to be lost; thus, limiting to extinction the usage and applicability of such valuable mathematical systems.

IMPLICATION OF THE STUDY

Any human society with evolved and applicable number systems and mathematical science has basic foundation for advancement in science and technology. However, mathematics on its own cannot envelope human development without deployment. It is only when numerical reasoning is allied to the qualitative reasoning typical of theoretical-real application can technological advancement be recorded. Formal and informal systems of education foster the development of mathematical principles which are deployed to commerce and economics, science and technology and everyday living. The role of culture and its influence in the way mathematical science evolve determine the perception of people understanding of world and their physical deductions of the elements that influence mater which in turn influence the advancement of science and technology.

RECOMMENDATION

With the world becoming a global communication with united number system and common language, there is need not to discard one's language and numerical system since many un-deciphered meaning remain locked in ethno-mathematical appreciation and numerical system. This will help both local and international users further

their understanding of applicable and abstract values which will increase close knowledge gap the evolution of science and art.

CONCLUSION

The current study is an effort to contribute in ethno-mathematics. The literature helped in underpinning that cultural differences contain inestimable dimensions which can be harvested to enrich the number system, mathematical/other sciences and its practical application in science and art. The study contended that the expression of numerical system is peculiar to cultures and house the potential for divergent appreciation of the numerical system, mathematical sciences and their usage in everyday living. Particularly, the study emphasized that, ethno-differences in the numbering system such as the base unit which determine mathematical number usage in science for example influenced the mathematical application and understanding of quantitative system. Such an influence have both implied and connotative impacts in understanding numerical structures and abstract quantification which govern the evolution of modern science and art.

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