

THE MATHEMATICAL NATURE OF AFA IGBO REPOSITORY AS OPPORTUNITY OF AFRICAN IDENTITY IN A DIGITAL CULTURE

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Abstract

The term “Digital” has become the buzzword of the modern age. In a sense it captures trend, modernity, currency, latest and so on. Digital is the adjectival rendition of the word “Digit” which derives from the Latin “Digitus”. Digitus is finger. The ancient tradition of counting with the fingers made the fingers associable with numbers. Today Digit has come to refer to number itself. Digit refers to individual numbers in a group of numbers. Igbo vigesimal numeric system was replaced with the decimal system by those who failed to explore the numerological values of numbers in Igbo and the intrinsic connection of numbers to the mechanics of physical bodies. This work explores the real connection of numbers to physical entities in the Igbo Afa system which opens up the past, present and future. Afa juggles and conjures two hundred and fifty six dualized entities built on base 4. It has both heuristic and algorithmic predictability. It promises to contribute to the digital algorithmic system and may offer faster computing procedure. Unfortunately, Africa has shown itself a consumer population of western inventions and technology. This position is a deficit to African global identity. This work proves that Afa gives Africa the possibility of a continental identity in a digital age. This study deploys the ethnomethodological approach in the study of culture.

Introduction

The word ‘Identity’ derives from a Latin root ‘*Identitas*’ which is used to capture an individual’s relational sameness with others. In other words, to derive an identity, the individual is placed side by

side collective characters, traits, behaviours and so on. From its very roots, the question of identity is the question of a sociology which seeks the conformity of the individual to collective traits and characters. Today, the subject of identity has become the subject matter of a psychology which seeks to individualize the human person into a self-standard; distinct and isolated. It is then safe to say that the question of identity is both sociological and psychological. On the one hand, sociology emphasizes collective identity in which an individual is viewed from the prism of social structure and arrangement. This individual is allotted a role by that identity or is found to express qualities, beliefs, characters, traits or behaviours with which the society had been known. On the other hand, psychology emphasizes personal identity which is made up of traits, characters, behaviour or personality which distinguishes one individual from others. This is without prejudice to the branch of psychology which studies groups as entities.

Nevertheless, the question of identity never ceased to be the question a philosophy which seeks the persistence of a person through time. That philosophy seeks the stable quality for which a person could be identified in spite of the passage of time. Influenced by the Cartesian distinct mind from a physical body, modern philosophy sought to define the person in terms of an isolated entity from any external force. Rene Descartes weakened the external connections of entities and focused on their individualizing characters and internal self-generating force to arrive at inertia. Cartesian physics evolved a three-dimensional space in a coordinate system in which the individualized entity resists every external force or influence. Thus John Locke asserted consciousness and memory over against Cartesian mind and body. For Locke, consciousness is at the basis for human identity since it links sensation and perception. Consciousness is the primary function of the mind which can be transferred from one soul to another. This way, Locke was able to navigate through the primary

search of philosophy into human identity. David Hume understood human identity as a collection of perceptions and experiences. He argued against stability and asserted that the human personality is transient. In the first place, Hume posed a two-dimensional perception – Impression and Ideas. He evaluated these in terms of their force and vivacity, understanding impressions as more forceful and vivacious. Immanuel Kant understood human identity as unity of experiences and self-consciousness. The validation and authentication of an individual is a self-conscious imperative lived as experience. These philosophers set the tone of modern discussions on identity before Erik Erikson blazed the trail in psychology. Erik Erikson delineated two features of human identity. On the one hand was personal characteristics and development, and on the other is social and cultural factors and roles. The neo-eriksonian era championed by James Marcia opened the door to modern conflict and contradictions in identity, especially gender identity.

However, this work is an ethnomethodological investigation into collective identity which focuses on the Igbo ethnic group. It builds on the hypothesis that the individual Igbo cannot be identified outside the group or at least outside the community which is a microcosm of the group. The individual person is first of all *Onyeigbo* (Igbo person). In an earlier work (Okpalike, 2020), the present researcher had explored the ontological implications of *Onweonye*, which was his concept of person in Igbo. *Onweonye* is a possessor and a giver who possess for the good of the community and gives to the community for their good. In agreement with Odimegwu (2008), he posited that the Igbo person is ontologically communal. The very search of this work is for that which will power the collective identity of the Igbo in a digital culture.

The present researcher focused on the creation of the digital culture more than the consumption of the products of that culture. Considering that mathematics is at the basis of digital culture, he

went ahead to seek the Igbo mathematical tradition and discovered *Afa* as the mechanism which puts Igbo mathematics to practical use. *Afa* is a proto-scientific device which utilizes both algorithmic and heuristic procedures to find solutions to problems in quick successions of steps through binary, quaternary, octal and hexadecimal bases. It is a proto-scientific digital device because it was designed from Igbo vigesimal numerical system.,

Derivation of “Digital” as a Concept

The Latin word “*Digitus*” which translated to “Digit” in English had to do with numbers. Meanwhile, from its very root in Latin, *Digitus* means finger or toe. Probably from the tradition of counting with the fingers, the word came to be associated with numbers. Digit is any numeral from 0-9, it is used especially to refer to individual numerals when there are more than one in a numerical statement. Simply put, digits are numbers. “Digital” is the adjectival form of “Digit”. In other words, when things are referred to as digital, it means that they have to do with numbers. Today the word relates to the storage and use of signals and data. The digital system is basically the use of series of numbers (digits) to generate the mobility of physical entities and program them to self-generate this mobility through designated commands. The digital system is the modern advancement from the analogue systems formerly operated as manual or automated machines. As an adjective, the word is often associated with technology, where it is used to distinguish its system of operation from analogue systems. The difference is that in analogue systems, numbers are continuous in the full scale of 0-9. On the other hand, in digital systems, numbers are discrete, especially expressed in a binary mode. Meanwhile, there are three perspectives through which “Technology” can be viewed:

1. Application of scientific knowledge in production
2. System, machinery and equipment produced from scientific knowledge

3. A branch of knowledge which deals with engineering and applied science

Digital technology, is technology driven by the generative energies or combination of numbers cast often in a binary mode (0-1). This level of technology is, in turn, driven by digital system. It is the modern replacement of analogue technology which relied on machines built from mathematical certainty or mathematics of numbers in a continuous full scale of 0-9. Analogue technology came to its apex in automation, but even that automation was the most which could be generated with a continuous full scale mathematics. This replacement created the possibility of predictability. Digital technology became self-generative of functions and mobility.

Africa's Consumer Population

Unfortunately, the Igbo, like the rest of Africa, had been more of consumer of digital technology than it contributed in creating it. It is amazing to find that studies and reviews of digital technology in Africa is centred around consumption, like the study done by Solomon and Klyton (2020), which investigated the impact of the usage of digital technology on economic growth in thirty-nine African countries from 2012-2016. So also was the World Bank brief of 2024 which reviewed how digital transformation drove development in Africa. In the brief, the availability and affordability of devices which use digital technology, access to and signal quality of internet facilities, volumes of digital payments made in transactions and so forth were investigated. The Igbo is one of the major tribes in the African continent and is included in these investigations.

In a general sense, Africa has not broken the chains which bars her access to the table of global discourses. Africans have normalized the status of spectators and consumers of global activities and products emanating from those activities, be they economic,

military, science, technology or even philosophy and religion. While Africa supplies the world with the physical raw materials needed in producing secondary and sundry goods and services, it is lost on Africans that their continent was also the reserve base of ideas and innovations which engineers the world. Once the western colonialists had discovered the enormous raw materials on which the African continent was seated, Africans themselves turned a blind eye to the enormous intellectual deposits of their ancient culture and the ancient scientific systems which could give them access to the table of global discourse, like digital technology. African intellectuals and academics look to the west for a lead into research and innovation; they end up serving the interest of the west in their endeavour and go ahead keeping Africa in perpetual subservience to western domination. Even as we speak, accessing grants, seeking awards, vying for recognition in well-established western systems and institutions is one of the ways of identifying a prestigious or prodigious African academic. African academics shy away from exploring the continent, find and develop the knowledge base which could give Africa a place in the table of global discourse. They rather embrace and engage with those investigations of Africa which are the areas of interest to the west and their agents through their always available grants and funds. It is my humble submission that if Africans excel in western mathematics, science and technology, they have only proved themselves worthy slaves serving the interest of their masters. The system, body of knowledge and idea, in as much as they are not indigenous to Africa, serves to further alienate Africans from Africa and make them subservient to a world they have been constrained to see as superior. Before Africa joins the league of world players, it must bring something African to the table of discussion. Unfortunately, the African intellectual has been trained to think that the farther he moves away from Africa, the more he becomes global. It is African intellectuals who have the task of saving Africa from intellectual servitude and it can only happen

when they go back to the African roots to seek things we neglected and how they can contribute to global discussions.

Traditions of Numbers and Their Relationship with Digital Technology

Perhaps it might be of help to do some historical excursus into the evolution of numerical digits in western education. Different civilizations and cultures had different mathematical traditions. While the ancient Egyptians and Mesopotamia developed tally marks and simple symbols to denote large values which cannot be represented in single digits, using base-60 system in Babylon and hieroglyphic numerals in Egypt, the Mayan civilization which was evidently an ancient black Mesoamerican peoples, renowned for their sophisticated culture had a mathematical tradition in base-20. Theirs was a vigesimal numerical system which even had the zero numeral. In India, Brahmagupta played a crucial role in the development of arithmetic by formalizing the concept of zero. This gave Muhammad ibn Musa al-Khwarizmi the impetus of inventing the positional notation with the inclusion of zero. It was al-kwarizimi's mathematical ingenuity and the development of the algebraic systems which opened up the use of numbers in geography, sciences and technology. Today, when we use the word Algorithm, it is actually a western corruption of that name al-kwarizmi who became arguably the father of modern numerical and digital systems. Thus the Hindu-Arabic system of positional notation in the decimal numeral system with zero was popularized and has become the standard mathematical system adopted by the west. With digital technology developing out of this mathematical tradition, no one seems to be questioning other mathematical traditions which could have more to contribute to the development of digital technology or create new frontiers to it.

Here, in Africa, traditions of numbers have been reshaped by foreign incursions, interruptions and interventions. There is scarcely any African tradition of number which is still intact or

faithful to its original African root. Huylebrouck (2006) studied mathematical systems in Central Africa and found numbers in basis 2, 4, 5, 6, 10, 20, 40 and 60, he compared them with the counting system of the bush men of Gugumal in Australia and judged that even their evident binary system “are not binary in a mathematical sense” (p. 138). In spite of the complex numbering system he found and the evident arithmetic involved in deriving numbers in arithmetic progression, he still understood these as counting system. This is a typical western view of Africa and concerted attempts to undermine Africa’s potential to bring something to the table of global discussions. There are other studies on African numerical systems giving credence to modulations to Greek and Roman decimal influences. In this intellectual space, it is my wish to launch the Igbo numerical system in relation to *Afa* data storage and retrieval system to showcase a possible African digital dawn only when intellectuals engage with its dynamics to bring out the hidden mathematics in it. This is because numbers are the fundamental building blocks of digital systems. These numbers are cast in binary, octal, decimal or hexadecimal forms to enable calculations and formation of logical statements. While Binary (base 2) is the foundation of the digital systems, the octal (base 8) and hexadecimal (base 16) are often used to ease the statements of the binary data.

Igbo Mathematical Tradition

Like all other ancient traditions had their mathematical tradition, the Igbo had the vigesimal numerical system; numbers in base-20. It has been suggested that this derives from the numbering of both the fingers and toes which were the ancient form of counting in different cultures. While some ancient western cultures used the fingers alone for counting, the Igbo counted with both the fingers and the toes. According to Umeogu, Etodike, Onebunne and Orjiakor (2019:21): “The Igbos used a mathematics system known as Okwe and Mkpisi which has similar principles to those of

addition, subtraction, multiplication, division etc.” On the one hand, *Mkpisi* derives from *Mkpisi Aka* (Fingers) and *Mkpisi Ukwu* (Toes). Therefore, the fingers and toes in Igbo are directly linked to counting or numbering. *Mkpisi* is the direct translation of the Latin “*Digitus*”. On the other hand, *Mkpuru* is another word related to numbers. *Mkpuru* refer to units. *Mkpuru Onuogugu* is “Units of numbering”. The full rendition of the other mathematical system mentioned above is *Mkpuru Okwe*, that is, “the seed of *Okwe*”. The Igbo language represents numbers in a very distinct way which points to their knowledge of the latent power/force in numbers and their relationship with nature.

However, the vigesimal system is also not unconnected with Igbo cosmology and numerology. In Igbo cosmology, four is a defining number, it occurs in diverse ways. There are four days of the week and twenty-eight days of the lunar month which set the tone for time and engagement with mystical reality. It also occurs in crossroads which extend to the four cardinal points of the earth; it is understood as both a rallying and take-off point of extended and extensive entities. In Igbo numerology four is completeness, referred to as *Ezumezu*. Therefore, to understand the Igbo universe, four and multiples of four must be explored. Twenty is a multiple of four into five times and five is the beginning of the second level/cycle after the completeness of a set of four, just as at twenty, the Igbo begins another cycle of twenty. Igbo arithmetic progression is typically vigesimal. The progression is thus: 20 (*Ogu*), 20^2 (*Nnu*), 20^3 (*Puku*), 20^4 (*Nde*) and so forth.

In demotic Igbo vigesimal numerical system, twenty is *Ogu*. *Ogu* is a definitional counter that can only have additional value by adding further 1-20 or by recurrence of 20. For instance, thirty five in demotic Igbo is *Ogu na iri na ise*, which means $20+10+5$, fifty eight is *Ogu n'abo na iri na isato*, which means $(20 \times 2) + 10 + 8$. In ancient Igbo numerical system, more complex calculations take place in microseconds to arrive at numbers and the average Igbo do

that calculation swiftly. Unfortunately, as it also happened with the alphabetical arrangements, in modern Igbo, numerical system has been decimalized to conform to the western system taught in schools. With the silencing of the Igbo vigesimal system, there is next to nothing the Igbo is bringing to digital technology, beyond offering a ready consumer population and a culture of learning the western system. Perhaps those who struggled and worked to achieve this decimalization did not know that numbers are not empty concepts. They relate to nature and are instrument for the interpretation of nature. Therefore, the Igbo vigesimal system was the key to unlock the secrets of nature, past, present and future. *Afa* is the computation and computerization system, albeit in its organic form, which put the Igbo numerical system to practical use. The Igbo modern digital system is struggling to sequel the west's and can only be subjected to it. Meanwhile, *Afa* emerges from a binary (base 2) formation, dialogues in a quaternary (base 4) combination, uses octal (base 8) and hexadecimal interactions to find solutions. Yet it is viewed as an Igbo ethno-religious culture. We see in *Afa*, a pattern of Igbo mathematical codification in base 2, 4, 8 and 16. *Afa* offers the proof that the Igbo vigesimal numeric system derives from the numerological significance of four; four is at the base of convergence and divergence of numbers. It is through *Afa* that Igbo mathematics can be applied to business enterprise, governance, science and technology as suggested by Umeogu, Etodike, Onebunne and Orjiakor (2019).

The Digital Foundation of *Afa* System of Data Storage and Retrieval

From the deposits of Igbo culture and tradition, and so it is for other African traditions and cultures, there are ways Africa can meaningfully contribute to the creation of digital technology. For instance, among the Igbo, the complex *Afa* system has not been explored by our intellectuals, especially for its codified mathematical systems. It has been sparingly studied as a religious

phenomenon or as part of Igbo ancient divination and, unfortunately, sometimes witchcraft and sorcery. Meanwhile African and Igbo mathematicians are engaged with Greek and Roman mathematical systems, ignoring the African mathematical system which *Afa* preserved. However, it is important to reiterate that mathematics is at the background of digital technology. As we have said earlier, in digital technology, numbers are deployed to achieve motion in a physical sense. The brand of *Afa* referred to as *Afa Ugiri* or *Afa Ukpukpala* is an Nri hegemonic *Afa* tradition which has proved to be an Igbo repository of digital knowledge. While modern intellectuals have fun relegating that scientific knowledge to a primitive past, as ancient divination method and practice of sorcery, it remains for them to divest that system of all religious decorations and distractions to find that *Afa* is a body of logic based on sixteen generative digits. To generate a value, each digit must interact with another. This basic duality makes *Afa* emerge only in binary fusion, function in quaternary interactions and finding solutions in octal and hexadecimal combinations.

In other words, *Afa* generates two hundred and fifty-six basic binary entities which are foundational statements relatable to human life and conditions. These foundational statements further interact with each other to generate non-contradicting and accurate logical statement of truths and facts. At this level, *Afa* speaks to human situations and conditions in real time, past, present and future. The digits of *Afa* are not immobilized mathematical entities as found in 0-9, they are interiorly connected to life and human experiences. The Igbo do not isolate the digits since they cannot have independent existence. Each draws from universal force with internal mobility to interact with another, so that the interaction of couples produce a logical statement relating to life and human activity. In other words, while the current digital experience operates 0-1 binary interaction with external forces to mobilize them, utilizing the Newtonian principle of inertia, *Afa* digital experience operates two hundred and fifty-six varieties of 0-1. To

make a logical statement, one 0-1 must interact with another 0-1, which is a total of four entities. It takes two entities for *Afa* to make a statement and four entities for it to make a statement which relates to life. The number four and the multiples of four is very important in exploring the mathematics of *Afa* and Igbo mystical and scientific universe.

To a consumer, the above discussion may appear unrelated to digital technology. But experts in mathematics and those who write computer programs will certainly relate. *Afa* is both heuristic and algorithmic. As heuristic, it goes beyond conventional and classic principles of solving problems, penetrates other realities in a quick succession of steps and creates more possible solutions to a problem. As algorithmic, it allows for a finite sequence of logic, creates conditionals and provides different routes to a solution. It therefore contains the possibility of automation. I have no doubts that *Afa*, as it is, is raw material to digital solutions. It remains for experts in mathematics to explore its depths to derive the nature of its entitative interactions, and code the results of such interactions. Unfortunately experts and intellectuals who should encounter *Afa* and study it, still relegate it and other scientific methods which are of African origin to a religious past which does not even worth existing, how much more studying.

In the course of my studies in African and Igbo realities, I have come to the judgement that *Afa* is not just a mystical system in demotic Igbo religion, it is also a philosophical system having its economic, social, psychological and political dimensions. Here, I assert that it is also a mathematical system founded on the cosmology and numerology of Igbo vigesimal tradition. It has its own language and logic for algorithmic and heuristic data storage and retrieval. Even today, the *Dibia Afa* who is the expert in *Afa* handles it as an ancestral deposit of religion, deploying its language and logic like mystery and preserving its language and logical

sequence as secret. It belongs to Igbo academics, especially experts in mathematics and data processing, to break the religious barriers of *Afa* and extract the more important digital and numerical basis. I believe, that will be the beginning of a whole new evolution of computer language and logic for software programmers and which even from its origins will be African.

Conclusion

Like the physical Igbo community, founded on a proven cosmology and ontology, penetrable by numbers, so also it is possible to create an Igbo digital community on Igbo numerical system. The Igbo is by nature identifiable in a presencing within the boundaries of a community. Igbo mathematicians, software programmers and data analysts should go to work now, divest *Afa* of all religious and mystical colourings to explore its clear mathematical basis. The Igbo tradition has kept the harmony between its vigesimal system, on the one hand, and the binary, quaternary, octal and hexadecimal systems. This harmony does not exist in the western system where the decimal system has no links with the binary system. To achieve mobility in the western digital system the force to counter inertia must be external, but in the Igbo digital system, numbers possess their own internal force at formation and are mobilized in a quaternary, octal and hexadecimal interactions. We believe that among the Igbo, it was a disservice, in the first place, to re-engineer their demotic vigesimal mathematical system into a decimal system which threw away the fundamentals of that mathematical system and which in turn gave clue to the understanding of *Afa*. Secondly, it is a disservice to the Igbo ancestral heritage to throw a blanket judgement on it, which captures it as primitive, without exploring its content in the light of new skills and intellectual tools. What we study today as western science, pharmacy, medicine, mathematics, architecture, philosophy and so on were once proto-scientific models referred to as alchemy, witchcraft or sorcery. Today, the mystery and secrets of these proto-scientific models have been replaced with studying and learning which opens the old to be

known and from it the new invented and innovated. Igbo academics should know better than staying on imported and borrowed systems while sitting on the soil of a continent which is the mother of raw material and immaterial resources. *Afa* is a proto-scientific model of digital systems begging to be studied. The findings therefrom promise to position the Igbo and Africa in the circle of global discussion on digital technology.

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