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Mathematics as a Tool in Human Capital Formation and Development in Nigeria

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ABSTRACT The objective of this study was to examine whether the study of mathematics as a subject or course has any significant relationship with Nigerian National Development. Also, to ascertain if organizations whose workforce are sound mathematically are more likely to achieve higher productivity than those whose workforce are defective, mathematically. The methodology used to elicit data for the analysis was a simple random sampling technique by which a total of 100 respondents were selected from three faculties of the Kogi State University, including the bursary department. The sample size comprised of both students, academic and non-academic staff of the university. This method was considered adequate for the study in view of the homogenous nature of the population surveyed. The study revealed that "mathematics" as a field of study, was the only key to technological breakthrough in any given society. And no society could make meaningful progress in science and technology without embracing the concept, logic and philosophy of mathematics which is the tap root to all scientific thinking minds. Despite these facts however, many Nigerian Chief executives hate being associated with the study of mathematics and would want to avoid it by all means if possible. The study therefore recommended that, mathematics should be made a compulsory subject or course at the first and second years of study in all the tertiary institutions of learning in Nigeria. And equally, it should be incorporated in the training curricula of all organizations in Nigeria be it private or public sector organization. It is only then that the workers' minds could be developed for sound logical and critical reasoning that would help them as better planners and decision-makers in management and general administration.

1. INTRODUCTION

"There is a problem; seek its solution;
You can find it by pure reason; for in
Mathematics there is no ignorabimus
(We shall not know". (Hilbat, 1900).

These were the words of David Hilbat, August 1900 as quoted by (Heppenhaimer 1990: 3). Hilbat's statement in a summary of wonder, hope and the belief that mathematics has a conclusive answer to all developmental problems – be it human or materials. It shows that any problem has a solution and if a problem shows impossibility for non-existence of a solution, it must be demonstrated. Any problem of human capital assets of an organization or, societal problem affecting national development of any country that proves to be difficult stands a chance to be solved beyond doubt mathematically and entirely through the use of logic.

At a time in the history of mankind when man became aware of his environment, the changes he observed in the phenomena prompted him to wonder and wondered greatly. The he tried to speculate on what could be at the base of reality. This quest for knowledge came in two distinct forms: first, some consider it only in the material aspect of being, whereas, others based it on both material and immaterial aspects.

In the history of national development, is the vital role of the philosophy of mathematics. Though it is relatively old for people of the developed nations, the discipline is also relatively new to the people of the developing nations in the sense that, the study comes with its discoveries in consonant with the age that studies it (Peter 2006: 6). Consequently, the task of this paper is to relate mathematics to human capital asset development of a society and what impact it can exert on the national development paradigm as a whole with particular reference to the present condition of the grossly untapped and undeveloped human capital assets in Nigeria.

According to Uche, Owolabi and Adewuminmi (2010), High rate of failure in amongst candidates of the accounting professional examinations is associated with poor backgrounds in quantitative methods. Therefore, as the language of accounting is highly numeric and quantitative, the study of advanced level mathematics and quantitative methods are highly essential in developing future professional accountants. Similarly, Nwigbo and Eze (2011) point out that, "when the United States of America was faced with the challenge of the Russian sputnik in year 2000, she resorted to a national radical comprehensive and the well programmed articulated attention to the teaching and learning of mathematics and mathematics sciences at all levels of her educational system. This, according to Ukeje (2001) involved a massive deployment of new and innovative programmes, strategies and projects in science and mathematics particularly, at the secondary school levels. An example of the importance of mathematics in human capital formation is the 'School Mathematics Study Group (SMSG). The 'forward' written on one of their publications states that, "the increasing contributions of mathematics to the culture of the modern world, as well as its importance as a vital and integral part of scientific and human education has made it essential that the mathematics in our schools be both well selected and well taught".

It is indubitable that the world today has gone nuclear and our generation is witnessing the globalization of world economy through the use of information technology vide the manipulation of computer wizardry. Thus, the use of computer has in all its ramifications enhanced the quest for national development and crave for intelligent, vibrant, resourceful and computer literate human resource team that can create high level competitive advantage on organizations' overall performance through the in-depth knowledge of the computer operations. This is because the developed nations today had from time, based their quest for national development on mathematical experience whose results are given without contradictions. Therefore, it is an established fact that, without mathematics, there can be no computer - for the computer works in accordance with mathematical principles. Ochepa (2002) believes that, if mathematics is the Queen and or, bedrock of science, it implies that mathematics is science.

Challenged by these view-points, this paper gives a philosophical and scholarly analysis of mathematics and its impact of developing a country's human capital assets that can positively affects its national development. It further examines in brief, the concepts of mathematics, human capital assets and national development which are the key terms and thereafter attempts a definition of them, taken into cognizance, all implications derivative or paradoxes found in them.

1.1 Objectives of the Study

Having seen from the above overview, the importance of mathematics on the existence of a society, this paper has the following specific objectives:

1. To determine whether an organization whose workforce is not mathematically sound can achieve the same level of productivity in terms of creativity and innovations compared to those with sound mathematical reasoning.
2. To ascertain if there is positive relationship between the study of mathematics and national development.

2. CONCEPTUAL AND THEORETICAL ANALYSIS

2.1 What is Mathematics?

The term mathematics has been given definitions by various mathematicians as well as philosophers. In an attempt to define this concept, it shall be given an analytical and descriptive approach.

Historically, David (1982) defines mathematics "as the science of quantity and space and their respective symbols." Pierce (1978: 12) in line with David's view says, "Mathematics generally speaking is a science of making necessary conclusions about quantity and space." For Doyle (1975:13) however, says, "as long as criminal dictation makes use of deduction as a methodology, it is considered as a branch of mathematics." While other conceptions hold that it is a science of order, many more see mathematics as the science of quantity, magnitude or number.

Consequently, it is obvious that David's concept or definition of mathematics implies that science of quantity and space are actually Geometry and Arithmetic. The former concerns itself with numbers and rules of their operations, while the later concerns itself with spatial measurement. Historically from the time Euclid 300 BC, Geometry has been a deductive science. It assumes a base and with some logical manipulations, builds an amazing complexity. This calls for the knowledge of methodological hypothesis it adopts for its conclusion. This includes primary ideas that are self evident and deductive process as proof.

This is perhaps what drew Piece (1978) to view mathematics as making necessary conclusion about space and quantity. It is also in disagreement to this fact that Cannon Doyle attributed the deductive method which he believes has a mathematical flair which is not necessarily based on quantity and space. He believes that common denominator in anything mathematical is therefore the phenomenon of deduction. His problem here is that he does not see logic as tool for the raw data of many disciplines but as a part of mathematics. Those who view mathematics as science of order do so due to the confusion existing between logic and mathematics, because in the development of class logic and mathematics, both used operations such as "+" and "x", e.g. a + a = a, and a x a = a (Ijioma 2000: 36).

Metaphysically, mathematics is viewed as that whose function does not relate to or introduce humanity to the objective world unlike botany and medicine. Rather, it introduces one to the world through ideal phenomenon such as circle, point, triangle, -4, 2-1 etc. which are in correspondence with physical observable world. This does not remove the coherent nature of mathematics so long as is free from contradictions. It is at this point worthy of note that the empiricists have in recent time come in terms with the concept of mathematics, that numbers and their properties belong to the real world and are incorrectly represented in formal contexts. Thus, mathematics is regarded as either part of physics which studies the world around us or part of psychology which concerns itself with neurological constructs (Ijioma 2000). This position argues however that mathematics start by such things as two apples plus three apples equals five apples. A formalized rule can be reached from this kind of thinking e.g. 2 + 3 = 5 derived from the definition of 2, 3, 5, + =.

2.2 What is Development?

To appreciate mathematics in its relation to national development, it is necessary to define precisely the term "Development" as is applied in this study. It is worth knowing that there is no universal definition of the term, 'development.' Some definitions are based on economic criteria, some on social conditions, while others are based on political considerations.

Development has been viewed economically from growth perspective. For the Economists, when an economy is growing for instance at the rate of 4% per annum, the socio-economic well being of the people will experience improvement or, development. Socialists on the other hand have also laid emphasis on the social aspect. To this effect, Deutsch (1971) made it clears that, development encompasses numerous processes of change which are frequently associated. These include spatial mobility, occupational change, and changes in role expectation, needs, behavior, associations and identity.

Political scientists in their numerous ideological beliefs have attempted the definitions of development variously. Thus, for Nyerere (1969) development is, "the development of people." He believes that the construction of roads, buildings and the high levels of output in a country are not development but the tools of development. He further emphasized that, "and increase in the number of school buildings can only be regarded as development if and only they are used to develop minds of and understanding of the people.

Furthermore, Boudeville (1996) distinguished three basic concepts; growth, development and progress. In doing so he said that "growth is purely a set of increases in quantities produced, Development is growth plus a favorable change in production techniques and in consumer behavior; progress is development plus a diminution of social tensions between groups within a society." This implies that while growth is economic process, development is social-economic in nature and progress in primarily social phenomena based upon economic growth (Hoyle, 1973).

From the foregoing therefore, one can attempt a definition of the term 'development' in this study as; socio-economic changes which are drastic and which touch all spheres of society. It entails the activation of society's socio-economic and political potentials in a combined continuous effort to overcome problem or indicators of underdevelopment. It also entails human progress as measured by members of the society concerned.

2.3 Instances and Relations of Mathematics and National Development

Consequent to the attempted definition and explanations above, it is obvious that the relation of mathematics and national development cannot be over-emphasized. Worthy of note is the relevance of mathematics to national analysts and planners who are primarily concerned with the spatial aspect of development. This implies that, they are interested in how economic development, social development, political development etc are reflected in space. This suggests that mathematics and national development embraces other disciplines. For example, looking at instances of national development in relation to mathematics, Edeh (2006) posits that, "A close look into the advertisement of a Japanese auto-technological marketing states that, 'good thinking, good product.' What does this means? It means that it takes a mathematical thinking to have a sound technological finishing of a product or a production process."

In his attempt to discover the true knowledge, Plato explains that the mind passes through four stages of development. At each stage there exist a parallel between the object presented to the mind and the kind of thought the object makes possible. Diagrammatically, these parallel modes of cognition are shown as 'Intelligible World' (Y) linking to 'Visible World' (X) with vertical line showing degree of relationship between the modes of thoughts in the intelligible and visible world.

The vertical line X to Y suggests that there are some degrees of knowledge at every point which is a continuous process. In this process, as the line moves from the convert form of reality to the highest, there is a parallel progression from the lowest degree of truth to the highest. The link is further divided into two halves – the intelligible and the visible world. This line is unevenly divided; the upper part which represents the intelligible world is larger than the lower part, the visible world, is smaller.

The unequal division shows that the lower degree of realities and truth are found in the visible world, while the upper degree of truth and realities are found in the intelligible world. These two parts are further subdivided into two each. This further division implies that each upper level above the lower is greater in terms of the depth of the existence of the degree of realities and truth.

From the point of 'X' to 'Y' shows the level of human enlightment from the Dark Age to the bright light. Worthy of knowing is the fact that, the object presented to the mind is not four kinds but that they represent four ways of looking at the same object (Stumpt 1975: 52).

The first level here is that of imagining. Plato sees it as the lowest level because it is simply the sense experience of appearance wherein these appearances are taken for as realities. An example that is obvious is shadow, which can be mistaken for something real.

The second level is Belief – Plato says that, "believing even if it is based upon seeing is still in the stage of opinion." By this he implies that even though the senses can see things vividly making the mind to believe what the senses have seen, it is out of good grounds for knowledge for they can be descriptive. For instance, the sea looks blue, but it is not the case that when the sea water is fetched in a bucket it will be blue. As such, "whether it be color, weight or justices, these are properties of things experienced under particular circumstance. Our knowledge about them are limited; dissatisfied with this kind of knowledge, the scientist looks further to the next level.

Thinking, which is the third level is at the stage of the intelligible world. This level is typical of the scientist character. Though the scientist makes use of visible things, but not with this vision of them.

For they are only symbols of reality that can be thought of but not seen. This is the mental activity that Plato refers to as the "Mathematician." He sees this level as high point of abstraction. Thus, "thinking" therefore represents the power of the mind to abstract from the visible object that property which is the same in all objects in that class even though such actual object will have other variable properties (Stumpt 1975). This means that we can think of man whether we see a small, large, dark, light, young or old person.

However, this level of thinking is characterized not only by its treatment of visible objects or symbols, but also reasoning from hypothesis. By this Plato meant, the truth taken on self-evidence but which depends upon some higher truth. Thus, he says, "you know how students of subjects like Geometry and Arithmetic begins by postulating odd and even numbers or the various figures and three kind of analysis… these data they take as known and having adopted them as assumptions they do not feel called upon to give any account of them to themselves or to anyone else but treat them as self-evident" (ibid). Though hypothetical thinking gives us knowledge it still isolates some truth from others so we move to the next level which is:

***Perfect Intelligence**:* The mind is never satisfied and so to be satisfied it must seek perfect knowledge found in the word of the intelligible world. The mind must be removed from all visible things to the form of these things. The forms are those intelligible objects such as the triangle and man that has been abstracted from the actual object. The mind no longer uses hypothesis at this level but the faculty power of dialectic. This where the human capital assets of any society are being developed for optimum performance either in politics, management, economics, engineering, medicine, arts, law etc. there is therefore no single person's faculty in the dialectic that functioned completely outside mathematical thinking – if there is, certainly that individual would perform sub-optimally in his chosen field or, would be a non-performer.

Consequently, looking at the national development from the point of political and economic reasoning, this level of reasoning being referred to by Plato as, "the level of Mathematical comprehension has been taken". Supporting this, is when Nyerere (1968): talks of development as the development of people, it is obvious that he was in line with Plato's pattern of reasoning. It is therefore clear that political Elites in our country need Mathematical mental aptitude to make qualitative, quantitative and scientific decisions that will bring about a better national development.

For instance, going by the Pythagoreans theory that, every thing consist of numbers – strange as this might be, but in considering the factors behind this Pythagorean ideas, it is convincing . Pythagoras interest in mathematics was borne of religious reasons. Confronted with the quest for the purification of the soul and yearning among men for a deeper religion that could provide the means for purifying soul and guaranteeing its immortality, Pythagoras gave in to science and mathematics the study of which they consider the best purge for the soul. In scientific and mathematical thought, they saw a move of life that more than any other kind was pure. This shows that thought and reflection represents a clearer contrast of life of trade and competition for various honors. As such, theoretical thinking or pure science and pure mathematics was considered by the Pythagoreans as a purifier of the soul, particularly, as mathematical thought could liberate men from thinking about particular things and lead their thoughts instead to the permanent and ordered world of numbers (Stumpt 1975).

It is an obvious fact that the bureaucratic nature of government and even private establishment is born out of a mathematical reasoning. A fundamental principle in mathematics that national development is premised on or, that is rooted on mathematical reasoning is the concept of 'calculus.' "Calculus" is the branch of mathematics which deals with rates of change. Calculus comprises of differential calculus, which deals with calculating the derivatives or rates of change of functions. Another component is the integral calculus which is concerned with integration. Constrained by the limitations and scope of this study however, we are concerned here with mathematical abstractions of infinitesimal calculus from the cloud to earth. Which, in the words of Hogben he subscribed that, "the history of mathematics is the mirror of civilization" (Hogben 1967: 26). This implies that no civilization can take place without the concept of mathematical reasoning. It is mathematics that lay the mental picture of developmental plans to project conceptualizations to implementation which is the architectural design of mathematics.

History has shown that Isaac Newton and Gottfried Laibriz were credited with the independent invention of the mathematical technique called the "calculus" in 17^{th} century – one of the highest of scientific revolution. In fact that revolution has in the history of mankind played a very vital role and has been a motivating force in no small measure in contributing to the progress of civilizations. Treated as a Webarian ideal type concept of generalization, revolution may be seen as a violent upheaval of a society and is capable of running its course over several years. On the other hand, some revolution does not involve sudden violent upheavals but are rather long-range processes of change with far-reaching results (Leiden and Schult, 1973). As such, there has been series of revolutions in the ages past not only in politics but also in religion, moral, technological, industrial, managerial, and scientific and many more forms in the Nigerian National Development paradigm.

Thus, in this paradigm of revolution, we can say of the American revolution of 1776, the French revolution of 1789 and the Bolshevik revolution of 1917, though they are many other revolutions experienced for contemporary analysis of which are not of relevance to the concept of this study. As posited by a revolutionist, "the French revolutionist most permanent contribution to the concept of revolution lay in the glory and dignity that it gave to it" (Calvert 2001). As a result of glory and dignity associated with this paradigm, many third world countries like Nigeria have in the past and even in the present experienced these changes for their National developments.

It is obvious at this point to know that change as a mathematical factor therefore, plays a very vital role in relation to National Development of a given society.

2.4 Tools for Measuring Relationship between Behavioral Variables

The Intelligence Testing (IQ): Intelligence tests often play decisive roles in determining whether a person is admitted to college, graduate school, or professional school in the US and most advanced countries. Thousands of people take intelligence tests every year, but many psychologists and education experts question whether these tests are an accurate way of measuring who will succeed or fail in school and later in life. Sternberg (1998) presents evidence against conventional intelligence tests and proposes several ways to improve testing. From the on-set he asked that, *"How Intelligent Is Intelligence Testing?"* According to him, "A typical American adolescent spends more than 5,000 hours in high school and several thousand more hours studying in the library and at home. But for those students who wish to go on to Colleges, much of their fate are being determined in the three or so hours it takes to complete the Scholastic Assessment Test (SAT) or the American College Test (ACT). Four years later they may find themselves in a similar position when they apply to graduate, medical, law or business school; they will be required to take the Graduate Recruitment Examinations (GRE). Herrnstein and Murray (1994) pointed out a correlation between scores on such tests and a variety of measures of success, such as occupational attainment. They suggested that the U.S. is developing a 'cognitive elites'— consisting of high-ability people in prestigious, lucrative jobs — and a larger population of low-ability people in dead-end, low-wage positions. They suggested an invisible hand of nature at work. Sternberg (1998) posits that, but to a large extent, the hand is neither invisible nor natural. We have decided as a society that people who score well on these high-stakes tests will be granted admission to the best schools and, by extension, to the best access routes to success. People have used other criteria, of course: caste at birth, membership in governmental party, religious affiliation. A society can use whatever it wishes — even height, so that very soon people in prestigious occupations would be tall. (Oddly enough, to some extent Americans and many people in other societies already use this criterion.) Why have the U.S. and other countries chosen to use ability tests as a basis to open and close the access gates? Are they really the measures that should be used? The answers according to Sternberg lie in how intelligence testing began.

A Brief History of Testing: Sir Francis Galton, a cousin of [British scientist] Charles Darwin, made the first scientific attempt to measure intelligence. Between 1884 and 1890 Galton ran a service at the South Kensington Museum in London, where, for a small fee, people could have their intelligence checked. The only problem was that Galton's tests were ill chosen. For example, he contrived a whistle that would tell him the highest pitch a person could perceive. Another test used several cases of gun cartridges filled with layers of shot, wool or wadding. The cases were identical in appearance and differed only in weight. The test was to pick up the cartridges and then to discriminate the lighter from the heavier. Yet another test was of sensitivity to the smell of roses.

Cattell (1890) a psychologist at Columbia University, was so impressed with Galton's work that he devised similar tests to be used in the U.S. Unfortunately for him, a student of his, Clark Wissler, decided to see whether scores on such tests were actually meaningful. In particular, he wanted to know if the scores were related either to one another or to college grades. The answer to both questions proved to be no — so if the tests didn't predict school performance or even each other, of what use were they? Understandably, interest in Galton's and Cattell's tests waned.

A Frenchman, Binet (1905) got off to a better start. Commissioned to devise a means to predict school performance, he cast around for test items. Together with his colleague Theodore Simon, he developed a test of intelligence, published in 1905, that measured things such as vocabulary ('What does *misanthrope* mean?'), comprehension ('Why do people sometimes borrow money?') and verbal relations ('What do an orange, an apple and a pear have in common?'). Binet's tests of judgment were so successful at predicting school performance that a variant of them, called the Stanford-Binet Intelligence Scale (fourth edition), is still in use today. (Louis Terman of Stanford University popularized the test in the U.S.—hence the name.) A competing test series, the Wechsler Intelligence Scales, measures similar kinds of skills.

It is critical to keep in mind that Binet's mission was linked to school performance and, especially, to distinguishing children who were genuinely mentally retarded from those who had behavior problems but who were able to think just fine. The result was that the tests were designed, and continue to be designed, in ways that at their best predict school performance.

During World War I [1914-1918], intelligence testing really took off: psychologists were asked to develop a method to screen soldiers. That led to the Army Alpha (a verbal test) and Beta (a performance test with pantomimed directions instead of words), which were administered in groups. (Psychologists can now choose between groups or individually administered tests, although the individual tests generally give more reliable scores.) In 1926 a new test was introduced, the forerunner to today's SAT. Devised by Carl C. Brigham of Princeton University, the test provided verbal and mathematical scores.

Shortly thereafter, a series of tests evolved, which today are used to measure various kinds of achievements and abilities, including IQ (intelligence quotient), 'scholastic aptitude,' 'academic aptitude' and related constructs. Although the names of these tests vary, scores on all of them tend to correlate highly with one another, so for the purposes of this study we will refer to them loosely as conventional tests of intelligence.

What Tests Predict: Typically, conventional intelligence tests correlate about 0.4 to 0.6 (on a 0 to 1 scale) with school grades, which statistically speaking is a respectable level of correlation. A test that predicts performance with a correlation of 0.5, however, accounts for only about 25 percent of the variation in individual performances, leaving 75 percent of the variation unexplained. (In statistics, the variation is the square of the correlation, so in this case, $0.5^2 = 0.25$.) Thus, there has to be much more to school performance than IQ.

The predictive validity of the tests declines when they are used to forecast outcomes in later life, such as job performance, salary or even obtaining a job in the first place. Generally, the correlations are only a bit over 0.3, meaning that the tests account for roughly 10 percent of variation in people's performance. That means 90 percent of the variation is unexplained. Moreover, IQ prediction becomes less effective once populations, situations or tasks change. For instance, Fred Fiedler of the University of Washington found that IQ positively predicts leadership success under conditions of low stress. But in high-stress situations, the tests negatively predict success. Some intelligence tests, including both the Stanford-Binet and Wechsler, can yield multiple scores. But can prediction be improved?

Curiously, whereas many kinds of technologies, such as computers and communications, have moved forward in leaps and bounds in the U.S. and around the world, intelligence testing remains almost a lone exception. The content of intelligence tests differs little from that used at the turn of the century. Edwin E. Ghiselli, an American industrial psychologist, wrote an article in 1966 bemoaning how little the predictive value of intelligence tests had improved in 40 years. More than 30 years later the situation remains unchanged (Sternberg 1999).

Improving Prediction: Sternberg et all, (1998 showed that, a test that measured not only the conventional memory and analytical abilities but also creative and practical thinking abilities could improve prediction of course grades for high school students in an introductory psychology course. (A direct comparison of correlations between this test and conventional tests is not possible because of the restricted sample, which consisted of high-ability students selected by their schools.) In these broader tests, according to Sternberg, individuals had to solve mathematical problems with newly defined operators (for example, X glick Y = X + Y if X < Y, and X - Y if X e” Y), which require a more flexible kind of thinking. And they were asked to plan routes on maps and to solve problems related to personal predicaments, which require a more everyday, practical kind of thinking. In this way, exceptional job performers can be produced. Similarly, Creativity can be measured - for example, in another study, Lubart and Sternberg (2000), asked individuals to perform several creative tasks. They had to write short stories based on bizarre titles such as *The Octopus's Sneakers* or *3853*, draw pictures of topics such as the earth seen from an insect's point of view or the end of time, come up with exciting advertisements for bow ties, doorknobs or other mundane products, and solve quasi-scientific problems, such as how someone might find among us extraterrestrial aliens seeking to escape detection. The research found that creative intelligence was relatively domain-specific — that is, people who are creative in one area are not necessarily creative in another — and that creative performance is only weakly to moderately correlated with the scores of conventional measures of IQ (intelligent Quotient).

The implications for such testing extend to teaching. The achievement of students taught in a way that allowed them to make the most of their distinctive pattern of abilities was significantly higher than that of students who were taught in the conventional way, emphasizing memory. Indeed, further research done by Bruce and Sternberg (2001) have shown that the achievements of all students improve, on average, when they are taught to think analytically, creatively and practically about the material they learn, even if they are tested only for memory performance.

Interestingly, whereas individuals higher in conventional (memory and analytical) abilities tended to be primarily white, middle- to upper-middle-class and in 'better' schools, students higher in creative and practical abilities tended to be racially, socio-economically and educationally more diverse, and group differences were not significant. Group differences in conventional test scores — which are common and tend to favor white students —therefore may be in part a function of the narrow range of abilities that standard tests favor.

Tests can also be designed to improve prediction of job performance. We have shown that tests of practical intelligence in the workplace can predict job performance as well as or better than IQ tests do, even though these tests do not correlate with IQ. In such a test, managers might be told that they have a number of tasks to get done in the next three weeks but do not have time to do them all and so must set priorities. Such tests do not replace conventional intelligence tests, which also predict job performance, but rather supplement them (Wagner and Sternberg 1999).

2.5 Relationship of Mathematics with Human Resource Management (HRM)

Why is Mathematics Important in HRM?: In the business world, everyone (Employees and Managers alike) needs the knowledge of and skill in business mathematics. While computers and calculators are used for many calculations, it is important to understand the concepts behind mathematical computation. The purpose of the mathematic course is to increase your students' and employees' mathematical knowledge and skill as it applies to many aspects of business and to help them be more valuable players in the business arena (Deitz and Southam 2003).

Supporting this view, Umukoro (2005) posits that, in business decisions, there is the further complication that people almost always are somehow involved. The presence of this human element makes it even more difficult to predict whether a decision will prove to be good, neutral, or bad. Quantitative judgments play an important role in business decision. These quantitative judgments help in building a quantum of quality bundle of the organization's human capital Assets.

The knowledge of mathematics helps the organizations' human capital to be rational and logical in their decision – making roles at all levels. As Qazi et al. (1980) put it, "Logic is analysis of language. And its study involves the learning of the principles and methods employed in distinguishing valid argument from those that are not valid. We start by knowing what a statement is. In our everyday language we come across statements that may be interrogative, declarative or exclamatory. In mathematics however, a declarative statement which is either true or false is called a statement. For example, each of the following is a statement – and some true or, false.

- Two is an integer
- A quadrilateral is a square
- A triangle has four sides. etc.

The understanding of this logical sequence is more profoundly enhanced in an employee with the help of mathematical reasoning. This helps greatly in decision making process in organizations.

According to Audre (2004) "a particular problem for management is that most decisions need to be taken in the light of incomplete information. That is, not everything will be known about current business process and very little (if anything) will be known about future situations. Therefore, the techniques described in business mathematics and statistics enable structures to be built up which help management to alleviate this problem – thereby building a quality bundle of Human Resource for competitive advantage.

A European study of innovation found that, 2 percent of new ideas originated from top management, 6 percent from middle management and 92 percent from first – line supervisors and other employees. How do we capture the innovation that is out and how does that become integrated into system and an equal chance to be approved and funded? We believe that simply giving all employees a voice and a choice plus the assurance that their ideas will be viewed and evaluated mathematically and quantitatively against other options may provide encouragement necessary to gather this lost potential. (Allan and Dean 1989).

2.6 Mathematical Applications in Human Resource Management Problems

Most human resource practitioners realize in an intuitive way that they are using a mathematical system when they apply quantitative methods, but probably most would not be able to say what the actual system is. A mathematical system depends on:

1. A set of elements (such as rational numbers, whole numbers, etc.)
2. Operations that can be applied to the set of elements (such as addition, multiplication, etc.)
3. One or more relationships (such as the equation: $1 + 1 = 2$)
4. Axioms that are accepted rules (e.g., the rule of identity which is expressed in the equation $a = a$)

While any system can be used, and human resource practitioners are accustomed to the simple rules and operations of the arithmetic system of real numbers, statistical practices often require the application of special rules and operations within the set of rules of the mathematical system. In a sense, that makes the statistical methods, a "subset" of the entire mathematical system that we use. This is essential to remember since statistical methods cannot exceed the limitations of normal mathematical boundaries. It is also important to remember that not all the tests or approaches may be appropriate, because the boundaries of normal mathematics might be exceeded in given situations (Thomsen 1978).

In statistics, these boundaries are called assumptions.

Mathematical Systems Example: What are the assumptions that a normal statistical review (e.g., bell-shaped curve) might require in comparing the results of performance appraisals between men and women in your organization? Thomsen (1976) outlined five basic mathematical steps appropriate in appraising and comparing performance between men and women in an organization to include:

1. The observations must be independent. That is, one measurement should not bias the other.
2. The measurements must be from a normally distributed population. That is, the traditional "bell-shaped" curve.
3. The populations must have the same variance
4. The measurement must be of at least an interval scale
5. The effects must be additive.

Types of Measurements: There are four basic kinds of measurements:

1. Nominal
2. Ordinal
3. Interval
4. Ratio

Nominal Measurements: The first of these, nominal measurements (or scales) are composed of numerical values that serve to identify discrete categories; i.e., the numbers are labels for the categories and imply no quantitative (measurable) differences that can be handled meaningfully in numerical operations. The numbers on front doors, for instance, constitute such a scale; Social Security numbers are another example.

In salary surveys, the numbering of positions or companies is just such a scale; the numbers are used merely as labels

Table 1: Nominal measurements example

Company name	*Company number*	*Position*	*Position number*	*Salary*
ABC Company	021	Secretary	91	₦ 24,000
ABC Company	021	Clerk	92	₦ 22,000
ABC Company	021	Typist	93	₦ 16,000
XYZ Company	043	CEO	11	₦166,000
XYZ Company	043	Clerk	92	₦ 18,000

The numbers are used for illustration purposes only.

Table 2: Nominal measurements example

Position	*Position #*
Secretary	1
Stenographer	4
Clerk	2
Typist	5
CEO	3

Nominal measurements allow only the most limited application. For example, one can count classes (the numbers of positions numbered “2” for instance). Or “Yes” - “No” can be counted where 0 - 1 correspond to “yes” and “no.” However, most human resource administrators will find that using nominal measurements in any kind of mathematical operation is bound to lead to error (Thomsen 1978).

Ordinal Measurements: Ordinal measurements have, in addition to nominal properties, rank differences. That is, the numerical value of these scales indicates that there are not only differences between categories but that these are quantifiable differences. An ordinal scale ranks “observations” with regard to the extent to which they possess more or less of a given quality. The ranks do not, however, indicate the degree of difference (how much more or less) of the property each observation has.

According to Thomsen (2001) There are events with dimensions that cannot be readily quantified. It would be absurd to state that a painting is twice as beautiful as another or that one restaurant has food one-third as tasty as another. For this reason, ordinal scales are often applied to observed events that differ along qualitative rather than quantitative dimensions (especially when the qualitative dimension cannot be easily expressed quantitatively). For example, in job evaluation plans, the following factors cannot be easily broken down into quantifiable units.

- problem complexity
- responsibility
- human/social challenges
- skill
- authority
- impact Profit

Can one job have two times as much the problem complexity as another? But within each factor there can be a breakdown of steps.

Ordinal Measurements Example: You have been asked to estimate the average salaries of individuals within Nigeria who hold the following degrees:

- PhD
- MBA /MSc
- BSc/HND
- BA
- High School Diploma

Table 3: Average salaries by degree

Degree	*Salary**
PhD	₦61,891
MBA/MSc	₦82,463
BSc/HND	₦50,438
BA	₦47,625
High School Diploma	₦31,112

* The numbers are used for illustration purposes only.

This measurement is very important. Performance appraisals are almost always on ordinal scales, yet human resource practitioners often try to utilize mathematical tests and computations that require more stringent assumptions (David and Thomsen 2001).

There are several other mathematical methods of computations used by Human Resource Practitioners and Administrators in performance appraisal and Evaluation techniques. The list is inexhaustible. From the nexus of the above analysis however, it can be seen that mathematics has a very direct impact on the formation and development of organization stock of Human Capital Asset. It is the wheel within which critical decisions are based.

3. METHODOLOGY

3.1 The Study Area and Population

This study was conducted in Kogi State University which is located in Anyigba town in

Dekina LGA - on the major trunk 'A' road linking Abuja (FCT), Lokoja to Enugu – Eastern part of Nigeria.

The university has a total number of six faculties – this include, The faculty of Agriculture, Faculty of Arts and Humanities, Faculty of Law, Faculty of Management Sciences, Faculty of Natural Sciences and the Faculty of Social Sciences. For the purpose of this study the faculties of management sciences, Natural Sciences, social sciences and the Bursary Department were selected for this survey. The three faculties including the bursary department have a total population of about 4,200 including staff and students.

3.2 Sampling Size and Technique

Due to the characteristics of the study population and the nature of the survey, a random sampling technique was used to elicit information from a total sample size of 100 respondents drawn from the total population of 4,200. A structured closed-ended questionnaire was designed and administered to the 100 respondents which were all retrieved and subsequently analyzed as shown below:

4. ANALYSIS AND DISCUSSION OF FINDINGS

Question One: From the Table 4, it was discovered that, 75% of the total respondents confirm their dislikes for mathematics while 30% attest that they like mathematics generally. This percentage number of people who dislike mathematics is highly significant and statistically relevant to this investigation.

Questions Two: The analysis of the respondents here shows that 95% of the total population sampled agreed that mathematics is compulsory and very important in their various areas of job performance or the field of studies as the case may be, while 5% said that mathematics in not compulsory to the performance of their duties. This cannot be divorced from the fact that in our every day life, every individual is involved in the application of mathematical concepts to the operation of his or her job operation. Both market women, petty traders, farmers, engineers, teachers, lawyers, etc all need some element or degree of mathematical thinking to be able to take some basic life decisions. This is more crystallized by the response of one of the driver who asserted that mathematical application is more profound in his function as driver. That was evidenced in all the responses received to "***Question Five***" when total of 100% respondents agreed that mathematics is helpful in everyday living and human interactions.

Question Three: Eighty six percent of the respondents agreed that the study of mathematics has positive relationship with organizations' growth and the national development in Nigeria while 14% are on the contrary. Despite this overwhelming reality however, 97% of the population surveyed were of the view that, they would want to avoid mathematics in their chosen field and 55% said that they would not encourage mathematics as compulsory course for all students in the Nigerian universities. This general lack of interest in mathematics by the Nigerian publics constitutes a major threat to our learning culture and a major impediment to the growth of science and technology which has sharply retarded our national development.

Table 4: Interview Analysis of Responses from Staff and Students of Kogi State University

S. No.	*Question*	*No of Resp.*	*Dept./Faculty*	*Yes %*	*No %*	*Total*
1.	Whether respondent likes mathematics	100	Management, Social, Natural sciences & Bursary Department.	30	70	100
2.	If mathematics should be made compulsory subject	100	"	95	5	100
3.	Whether mathematics has positively Relationship with national Development.	100	"	86	14	100
4.	If people with mathematical Knowledge would have higher Productivity at work	100	"	48	52	100
5.	If mathematics is useful in everyday Human interactions	100	"	100	0	100
6.	If one wish to avoid mathematics	100	"	97	3	100
7.	If Mathematics should be compulsory at higher institution of leaning	100	"	45	55	100

Source: Data from field survey 2010.

5. CONCLUSION

This study was focused on the study of mathematics and intelligence as tools in human capital formation and development in Nigeria. The study was carried out in Kogi State university with a sample of 100 respondents selected from among the academic and non-academic staff of the university including students from various programmes of the three largest faculties studied. The study revealed that mathematics is very central in the development of the total tock of the nation's human capital assets and that without the knowledge of mathematics most executives are devoid of logical reasoning and thinking.

From the results of various respondents, it is an indubitable fact from the issues raised that, mathematics plays an indispensable role in national development and therefore, to think unmathematical is to think naïve, irrational, and unscientific which retard technological advancement of a nation. For workers to be sound mathematically is to make them technology-driven. To think mathematical, is to think fast, act fast, work fast, solve problems fast, produce fast and to develop fast. This is the realm of those who think mathematical.

6. RECOMMENDATIONS

Over the years, the Japanese have attributed their technological excellence to good thinking which is only obtainable in the intelligible world which is the mathematical world. Nigeria as a developing nation can do better in development paradigm if mathematics is considered as a panacea in its developmental policy thrust. In view the above, this study therefore recommends that:

1. The philosophy of mathematics and logic is properly given attention in all levels of the nation's educational system.
2. The study of mathematics in our tertiary institutions of learning should not be regarded as a General study (GS) courses but as a core course for all students in our tertiary institutions at first and second year of study.
3. Since mathematics enhances the level of human reasoning and further develop the mind, technical and generic courses undertaken by staff in any industry should continuously incorporate some level of mathematics in their training curricula. This will further develop the minds of our present and future leaders for better decision making and be more scientific in general management and public administration.
4. Finally, it is equally recommended that if workers are consistently made to undergo mathematical drilling in their training programmes irrespective of the industries they belong to, analytical and thinking ability will be refined, scientifically modeled which will ultimately result into higher productivity that would lead to technological breakthrough.

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