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SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR TRANSFORMATION, REFORMATION AND MORAL DEVELOPMENT IN A DEPRESSED ECONOMY

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ABSTRACT

The negligence meted on affective learning domain has prevented the realization of the intended objectives of the senior secondary school physics curriculum in Nigeria. This negligence was markedly manifested from the mid-1970s and had often and now thrown Nigeria into economic recession which is foresee ably slipping into depression, upon the gradually growing loss of concern for moral obligations beginning from the level of government to family households. How the scientific attributes of physics education can be harnessed and channeled for transformation, reformation and moral development of adult persons and youths in a depressed economy is now the challenge that occupies the centre stage of this study.

KEYWORDS: Scientific Attributes, Physics Education, Reformation, Transformation, Moral Development And Depressed Economy.

INTRODUCTION

In every nation of the world, education has been endorsed as an instrument par excellence for effecting national development. One of the key but unpopular recognized areas of such development is the moral development of youths and adult persons in developing countries such as Nigeria, nay Africa. This paper examines the scientific attributes of physics education for transformation, reformation and moral development of youths and adults in a depressed economy.

Given the low index of enrolment of learners, recruitment of teachers and educators in this area of discipline, much is not therefore realized of the immense contributions of education physics through its scientific nature of attitudes, to transforming and reforming the society for moral development of a meaningfully large proportion of the citizenry. The low realization of this contribution is largely due to neglectful disposition of the Nigerian education enterprise, to the affective domain of learning, consequent uponoverem-phasison the cognitive and psychomotor domains. This overemphasis seems to have now precipitated loss of focus on morals such that neighbourly feelings of empathy, emotions, interest, value, dignity and integrity are gone and replaced by vices. This replacement has scaled up Nigeria into bureaucratic corruption that has pervaded all fabrics of the society.

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CONCEPTUAL FRAMEWORK

Today, Nigeria is grappling with a receding economy, after this receding level, there may come a depression. This is a condition in which a nation is plunged into severe and several years of sustained long term economic downturn arising from contraction in activity of one or more of her economies of scientific origin especially the oil and gas economy of Nigeria.

Recession is a slowdown in economic activities over the course of a normal business cycle. Science in its knowledge design processes of experiencing, conceptualizing, analyzing and applying Kalantzisand Cope (2010) has suffered distortion in its customary definition across developing or underdeveloped cultures.

This distortion is reminiscent in its various shades and shapes of definition carrying the phrase "body of knowledge" with utter disregard of the attitude dimension located in Krathwohl, Bloom and Masia (1964)'s affective domain of educational objectives. This is the domain from which rectitude moral probity, obligation and responsibility are derived, but are now found neutral in the assessment mechanism of the Nigerian educational concerns, even though it controls all cognitive and psychomotor processes (Abonyi, 2011).

Presenting what at most seems tobe all-inclusive definition of science, Eshiet (1993) defines science as a body of knowledge in which human quest to understand natural-phenomena and respond to challenges are conducted through processes by which the knowledge is testable, verifiable and falsiable"

In agreement with the position of this paper the phrase, "which human quest to understand" is a description of "curiosity" as one of the scientific attributes of physics for moral development of practitioners

SCIENTIFIC ATTRIBUTES

All affective behaviours or learning outcomes which serve as safeguard to scientists in their investigation constitute what is generally known as scientific attitude. Carinand Sund (1975) and Emina, Argbomian and Inomiesa (1993) Adeoye, Okoronka, Okonkwo and Ogunsola-Bandele (2006) explain some of them to include:

i. Precision (diminishing possible or standard error)
ii. Accuracy (ie diminishing relative error)
iii. Rationality (ie application of rigours to logic in its mental content)
iv. Open-mindedness (ie receptively to information through search for relationship, freeing from prejudices and personal biases).
v. Suspended judgment (ie avoidance of rushed conclusions before all the facts are gathered or before all the data gaps are filled).
vi. Objectivity (ie intellectual honesty in reporting truly what has been observed, measured or discovered while collecting, analyzing, evaluating and interpreting data).
vii. Curiosity (ie the habit of searching for explanations where there are data gaps upon getting fascinated with events around).
viii. Aversion to superstition (ie dislike or avoidance of unreasonable beliefs or conclusions from unrelated occurrences).
ix. Tenacity (ie positive approach to failure by not giving up very easily as it is often said "when you fail, try, try, try, again)".
x. Honesty (ie collecting, analyzing and interpreting data faithfully without deliberately distorting the data trends).
xi. Questioning (ie asking questions both divergently and convergent on what, how, where and why?)
xii. Humility (ie freedom of knowing very little of the ever broadening horizon of

knowledge, and from observed unpredictable behaviour pattern of human beings).

xiii. Skepticism (ie a scientist tendency to free oneself from dogmas, by resisting to accept information blindly and unquestionably).

xiv. Respect of the views of others by reading about related works of other scientists.

xv. Perseverance (ie being patient with unexpected outcomes of several scientific investigations).

Knowing that the acquisition of scientific attitudes takes times, but it becomes effective and functional once acquired (MacCrakes, 1968). From psycho mechanical attribution, attitude is a learned construct correlating with personal, social and cognitive variables evaluatively directed towards or away from the influence of consistency of a specific stimulus. Kobella (1989) posits that scientific attitudes are normally associated with the mental processes of scientists. It is noted that scientific attitudes possess attributes thought to be either true or false and do not express evaluative quality. Most of these attributes are not strictly characterized by being positive or negative as is known of psychological attitudes. To lessen the sematic confusion, science educators prefer to label scientific attitudes as "scientific attributes" and as a distinct nature of physics.

Physics is seen as a natural science concerned with the interaction of matter in relation to energy and motion. A public understanding of the science of physics is more understood in science education generally and physics education specifically, to "provide basic literacy in science and physics for functional living in the society" (Federal Ministry of Education Senior Secondary School Physics Curriculum FME, 2009). Gbamanja (2014) defines science education as the interrelationship between the discipline of science and the application of educational principles to the teaching, learning and understanding of science. From this conception, physics education may be seen as the interrelationship between the discipline of physics and the application of educational principles to its teaching, learning and understanding. The scientific attributes typify the nature of physics and serve as a vehicle for education of citizenry of any nation at the threshold of scientific culture.

Observing that the cookbook practice in African school science, nay physics, has debilitated the continent from tapping the world's quantum of scientific and technological knowledge due to lack of acquisition of scientific attributes below the threshold, Maduemezia (1997) in Ajewole (2005) bitterly laments that:

i. Africa does not develop scientific culture
ii. Africa does not know the meaning of science/physics
iii. Africa does not know the uses of science / physics
iv. Africa does not know how science/physics is developed.
v. Africa does not know how science / physics is applied to development
vi. Hence, Africa does not know what kind of science/physics to teach and how to teach it.

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR REFORMATION

Given therefore the avalanche of what Africa does not know as above enunciated, there is pressing need for reformation of the present physics education practice which over many decades of years now, does not lift African nations beyond the threshold. Being simply the act of becoming, education according to Sesay (2014) is an organized system of influences which promotes all-round development whether social, mental, physical, spiritual and moral (psychological/ emotional). This definition is a corroboration of Fafanwa (1974)'s description of education as the aggregate of all processes by which a child develops the abilities, attitudes and

other forms of behavior which are of positive value to the society in which he or she lives. This means that it is a process for transmitting culture in terms of continuity and growth and for dissemination of knowledge either to ensure social control orguarantee rational direction or both. Sesay (2014) adds that education is the process by which society's values, customs and traditions are transmitted from older generation to the younger. This helps to facilitate the continuity of the society by maintaining its economic and political ideologies and ideals.

In acknowledging the powers of education to transmit cultures inter generationally, Gbamanja (2014) believes that education is the cornerstone for development and that science/physics education is the gateway to achieves stainable development in socio-economic terms. Following from above, physics education attributes, if inculcated in learners to the extent of assuming the stage of a science culture, can serve as an applied field of human resource development that strives to promote skills and knowledge which enable persons to be meaningfully engaged in activities of the society.

This engagement can evolve capacities which effective utilization is the critical factor in determining the growth, development and prosperity of the economy of a nation.

Such capacities call for frantic and deliberate efforts to reform the physics education practice. This call is imperative because, even though Africa nations, nay Nigeria, see physics education technology as the "magic" to achieve economic development, there is a mismatch between what is promoted and what is really practised. Reformation is an initiative for complete change of a situation in order to improve it. Based on this observed mismatch, most of the radical innovations introduced in the senior secondary school physics curriculum are in favor of cognitive and psychomotor behaviors with least consideration for the affective behaviors which serve as the driving force of those other behaviors to thrive. Physics education attributes are located thus in the affective domain and are critical to reformation of educational concerns.

The Federal Ministry of Education Senior Secondary School Physics Curriculum FME, (2009) acknowledges the reform initiatives inherent in physics education attributes, and states:

Following the Federal Government reform in education and the need to attain the Millennium Development Goals (MDGs) and the critical target of the National Economic Empowerment and Development Strategies (NEEDS), which can be summarized as: value-reorientation poverty eradication job creation, wealth generation and using education to empower the people, it has become imperative that the existing curricula for senior secondary school should be reviewed and realigned to fit the reform programme (P1)

Given this awareness of `reform initiative towards Sustainable Development Goals (SDGs), Nigeria needs:

i. A reasonable size of scientific labour force and training system.
ii. Expanded scientific and engineering research activities that would benefit socio-economic development.
iii. Improved labour force capacities for the creation of new knowledge and skills through sustained acquisition of scientific attributes of physics, and technologies that can be applied to enhance these capacities in medicine, agriculture, environmental sciences, engineering and other fringe disciplines.

These three cardinal needs are more than scientific literacy which Umoren (1997), Deboer (2000) and Gbamanja (2014) define as public understanding of the science of physics in order to live more effectively with respect to the world of nature. Simply, scientific literacy means that a sizeable proportion of the citizenry can ask, find,

or determine answers to questions and issues derived from curiosity about everyday experience. Hence, one can then say that scientific literacy in physics refers to a broad and functional understanding of the science of physics for general educative purpose. Beyond scientific literacy, the three cardinal objectives above stated, require preparation for specific scientific and technical careers.

Such can only berealized if physics is properly taught in schools for learner's acquisition of scientific attributes and sustained life and living as against the cookbook approach still prevalent in schools, wherein practical physics is organized less than two weeks after receiving practical examination instructions and before the said examination.

The pursuit of these needs dictates a new direction for reformation of physics education, which teaching and learning have to shift from the west centric conception, theoretical and didactic pedagogy to endogenous capacities, practical and dialectic pedagogy upon utilization of knowledge design processes of experiencing, conceptualizing, analyzing and applying.

This conception equally moves teaching from the speaking professional domain to the documenting and designing professional domain (Kalantzis & Cope, 2010). This is the centre of the reform which views "teaching technology, defined as scientific knowledge, skills and disposition put to practical use in solving human problems.

This definition is corroborated by Harrison (1970) that technology is the disciplined process of using scientific knowledge, skills and dispositions for solving human problems. The extent of its mobility or transfer through cultures is regulated by transformative processes and mechanisms allowed by such cultures using negotiation and or use of force (Inyang-Abia, 2004).

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR TRANSFORMATION

Literally, both reformation and transformation can be interchangeably used as complete change in the appearance, form and character of something or someone from a former condition to later condition. But the higher the degree of transfer change, the more reformation tilts towards transformation. This means that the more radical and dramatic a mobility of change is, the more transformative it becomes. In Nigeria, the scientific attributes of physics education witnessed transformation phases as the nation experienced transformation from pre-colonial (before 1840) through colonial (1842-1960) to post-independence Nigeria (1960 till date) (Inyang–Abia, 2004).

Similarly, work, civics and personal life passed through processes of societal transformation from early industrial society, through developed industrial society to knowledge society or the digital age. In like ways, educational paradigm of didactic teaching was experienced in the institutionalized mass schooling of early industrial society; educational paradigm of authentic education was experienced in the 20th century modern school, while learning by design (a vision for new learning) experiences transformation (Kalantiz & Cope, 2010).

During the pre-colonial Nigeria, Eshiet (1993) andInyang-Abia (2004) furnish that forest states, city states and kingdoms which formed the amalgam, called. Nigeria, inculcated scientific attributes unconsciously in their daily activities, but noted the following features:

i. Scientific attributes were based on tradition and were considered secret and magical (especially in the areas of medicine and agriculture).
ii. Scientific and technological practices were not documented but were passed through oral tradition

iii. Scientific attributes were transmitted through family lineage and units where specialization was required.
iv. Science and technology were more of product-focused than process and attitude-focused.
v. High exertion of energy was required in most scientific and technological activities of concern.
vi. Communal and interdependent lifestyles were promoted and so science and technology were tied to social life, nature gender and belief-system (religion), thus, unemployment was uncommon and unknown.
vii. Scientific attributes were not consciously inculcated in pre-colonial Nigerians but were translated into their indigenous practices and appropriate technologies such as: iron works, copper works, sculpturing, textile, weaving, pottery, hair weaving, beauty treatment, farming, fishing, hunting, crafts, dyeing, leather works, dress-making, beads work, carving and smithing.

In the colonial Nigeria, Fafunwa (1974), Eshiet (1993) and Inyang-Abia (2004) maintained that the preconditions and scientific base needed for science and technology to thrive were not established. Inyang-Abia(2004) culls out these preconditions and scientific base into what he calls "requisites for scientific transformation" outlined to include:

a. Capital.
b. Scientific base (since the 5 Rs–wRiting, Reading, a Rithmetic Religion and aRt were not supportive).
c. Well-trained and committed citizenry (scientists, engineers, technologists, technicians/ artisans, artists and teachers).
d. Prioritization of socio-cultural and economic problems.
e. Dependable energy source.
f. Administrative and political supports.
g. Essential and scientific attitudes or attributes needed for moral development.

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR MORAL DEVELOPMENT

Physics education has high propensity for moral development through the acquisition of its scientific attributes. This has been recognized in one of the objectival provisions for physics teaching curriculum FME (2009) stated: "consequently, the general objectives of the physics curriculum remain to acquire scientific skills and attitudes for technological application of physics". Similarly, the National Policy on Education NPE (2008) provides in one of its objectives of Post Basic Education and Career Development (PBECD) thus: "to raise morally upright and well-adjusted individuals who can think independently and rationally, respect the views and feelings of others and appreciate the dignity of labour".

Theoretically, moral development is located in the affective domain of taxonomy of educational objectives stated and propagated by Kathwohl, Bloom and Masia (1964), with emphasis on attitudes, feelings, emotions, motives, interest, values, persuasion, equality, quality, dignity, etc.

From the past four decades precisely, from1980s, the Nigerian educational system seems to place higher priority on cognitive and psychomotor (sports) learning for certification, with lopsided attention paid to moral behavior development, which serves as anchor to these other two domains of learning. This "mad race" for possession of certificates by means and crooks preoccupies the Nigerian educational scene. For focus, this study shall consider four components of affective behaviors having direct bearing on moral development of the citizenry. These include: equality, quality, dignity and value. The author envisages that the scientific attributes of physics education can contribute to improve youths and adult on the virtues of moral

development. This is viewed from the depth in which the citizenry is enmeshed in bureaucratic departures from moral best practices acceptable anywhere in the world.

This is evident now that the observed fantastically bureaucratic corruption is ravaging the nation and its economy, thereby increasing the width of inequality in education, market forces, employment, politics and survival.

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR EQUALITY

Two of the five main national goals of Nigerian education system include the building of "a just and egalitarian society" and "a land full of bright opportunities for all citizens (NPE, 2008). These goals are based on equality or egalitarianism. Scientific attributes of physics education have the potentiality to contribute to equality of every individual. This can be seen in attributes of objectivity, suspending judgment till all data gaps are filled, precision, accuracy, respect for the views and feelings of others, patience or perseverance with all. To this extent, discrimination on the bases of gender, ethnicity, religion, infirmity, background, class exceptionality and geography that tend to breed disadvantages orexclusion can be discouraged. Sesay (2014) maintains that one way of doing this is to put in place a multicultural education. This is education for multi-perspective changes based on equality of opportunities created by diverse anthropological, linguistic and sociological contexts of learning environment in physics classroom.

Sesay (2014) informs that a multicultural education sprang up from civil right movement of the 1960s in the United States of America, to address racial discrimination against Blacks in areas of education, housing and employment. On the basis of science education in general, and physics education in particular. Bean(1988), Tobin (1991) Gallard (2000) and Sesay (2014) outline the characteristics of multicultural education for moral development to include that:

i. It is antiracist/anti-ethnocentric
ii. It is basic education
iii. It is important for all children / learners
iv. It is pervasive
v. It is critical pedagogy, and
vi. It is education for social justice

These characteristics indicate that physics education for equal opportunity has to cover four levels of equalopportunity for: access, survival, output and outcome (Sesay, 2014).Education for equality of access refers to providing opportunity for children and adult individuals to be guaranteed chances of being educated irrespective of any facts of exclusion. The concept of Education for All (EFA), is one of such deliberate policies, but has failed for lack of political will on the part of politicians to provide moral oversight functions, and educators to do the job of educating the children for learning to occur.

Also, equality of survival refers to equal opportunity situation in which every child is provided equal chances to complete the cycle of education programme of pursuit. This requires that promotion to new class should be based on sound criteria, not mass promotion as is currently the case in Nigeria secondary schools, not when not qualified in terms of admission criteria; not through financial inducement, and not being moved through "sexually transmitted grade or score" (Sesay, 2014). Similarly, the concept of equality of output refers to equal opportunity situation in which every child is given equal chance to demonstrate ability to perform academically, technically and professionally at comparable levels of any activities of exposure to training. This disabuses situation in which graduands of senior secondary school A perform high level physics because of better background in mathematics and chemistry, while those of school B cannot do simple mathematics or write a

good application letter for job. Conversely, graduands of school A should not be known in the community to be of loose moral (such as vices of stealing, armed robbery, street-fighting street children, prevalence of teen pregnancies, children and women trafficking, pick-pocketeering, cultism, kidnapping, unlawful killing, rape, "four- one-nining", etc.), while those of school B are well mannered and identified with respect, kindness motivations, high achievement, selflessness, etc.

Again, equality of outcome refers to equal opportunity situation whereby every child has comparable and available opportunity to compete for position in which he or she may qualify for. Such opportunities may be employment, further education, demand and supply of goods and services.

Sesay (2014) advises that there should be strictly discouraged, a situation where there are "different strokes for different folk". In other words, where there may be no equality, there should at least be equity (ie fairness-proportional opportunity for representation). Although equity may approximate to inequality, there is quality in equitable distribution. In Nigeria, this is a policy to be taken care of by instituting National Character Commission. But to what extent does it work for the less privileged?

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR QUALITY

An educational system that sufficiently performs towards attaining societal goals is described as quality educational system. While equality of opportunity for access to education brings about quantitative growth, investment in education brings about increasing standard, and paves way for quality education.

Nwogwugwu (1990) presents outlines of definition of quality according to Webster's New International Dictionary of the English Language (1986) as follows:

i. Quality is peculiar and essential character of a thing.
ii. It is degree of excellence
iii. It is the degree of conformity to standard (as a product of workmanship).
iv. Quality is a merit or superiority because of a combination of good characteristic.
v. It is a condition of inherent or enduring good traits that make one somewhat superior.
vi. Quality is an attribute that obtains only after a certain level has been reached.

A quality is either good or bad and high or low. The nature of a good quality physics education should be multicultural, in order to be able to address the challenge of diverse languages, customs, traditions and experiences that Nigerian learners bring to physics classrooms as learning environments. In this context, physics learning is regarded as an interpretive process of making sense of experience in terms of extant knowledge, process skills and attributes. Gallard (2000) in Okebukola (2002).

The contribution of scientific attributes of physics education to good or high quality can be seen in terms of good characteristics or traits that can be promoted towards excellence or superiority in its learning. Such attributes as suspending judgment, rationality, open-mindedness which characterize physics education teaching-learning situation, if well imbibed, mean much for acquisition of quality physics education. One way of ensuring this, is putting in place a strong and virile teacher education institution for effective dispensation of quality instruction delivery. Sesay (2014) presents the recipes of institutionalizing a cadre of high quality and dedicated senior secondary school physics teachers to include:

i. Equal emphasis placed on teacher's knowledge of: content, pedagogy, the learner and the learning environment. This

knowledge is called pedagogical content knowledge, pck (Shulman, 1986; Cochran, 1997; Okebukola, 2002).

ii. Developing top-notch curriculum for senior secondary school physics.

iii. Providing modern, adequate and effective infrastructure for instruction and learning such include facilities, equipment and apparatus. These may be provided in concrete terms of architecture and electronics for management of class size.

iv. Paying physics teachers well and when due

v. Providing incentives and merit awards for excellently performing physics teachers. This should be guarded against teacher involvement in exanimation mal practice.

vi. Providing effective pre-service and regular in-service training programme to keep physics teachers abreast of new best global classroom practices for his or her students to "shoot high".

vii. Selection of physics education candidates based on strict qualifying criteria, and not as dumping ground for "left-overs or rejects" from other science and science-related disciplines such as engineering and medical sciences.

viii. Professionalism should be strictly brought to bear on physics/ science teacher education programme through practice on the basis of licensure, in both theory and practical examinations. This should be seriously considered by Teachers Registration Council of Nigeria (TRCN) which enrolment is still free for all (upon payment of specified amounts by graduating students and serving teachers).

ix. Establishing national and state accreditation and reaffirmation of accreditation teams for physics teacher education programme through periodic evaluation (say 5-7 years). This will induce governments and proprietors of private secondary schools to inject fund stowards improvement of school infrastructure in a more dignifying way.

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR DIGNITY

The scientific attributes of physics such as humility, patience, perseverance and respect, can attribute to dignity transferable to the civic, personal and labour lives of physics education practitioners (students and teachers) and share holders (parents and the general public or society). Dignity of a person is a quality of moral value associated with calm, controlled behavioral disposition and deserving respect. The National Policy on Education NPE (2008) capture the essence of dignity as a value to be inculcated in physics teacher education candidates through quality of instruction, upon enacting phrases such as: "respect for the dignity of the individual" and "appreciate the dignity of labour". From the perspective of "Afrocentric" value system, dignity is highly cherished. Today, African way of life has suffered severe battery and is polluted by acts of insolence, assault, insult, cultism, rape, sexual harassment (where women and girls are simply regarded as sex-obsessed objects by male and other female partners).

There lies the hope that given the disciplined disposition of physics as a fundamental science subject practised, taught and learnt in science workshop, laboratory and classroom, a change of attitude toward scientific attribute ofvalue is morally imperative (Sesay, 2014).

SCIENTIFIC ATTRIBUTES OF PHYSICS EDUCATION FOR VALUES

From the background of ethics and character building education, values are rules that direct moral or ethical decisions that are considered with right or wrong (Kobella, 1989). Unlike attitudes that range from positive to negative, values seem to be always positive. This implies that there should be nothing like "positive or good value and negative or bad value". Western cultures are distinguished by six basic values of

truths, beauty, goodness liberty, equality and justice (Adler, 1982). Culled from here, Shrigley, Kobella and Simpson (1988) identify three core values of science/physics teachers in Western cultures to include: academic achievement, pollution-free environment and symmetry in nature. Although physics does not answer moral questions Mbipom (1984), but the practioners shareholders and stakeholders are enmeshed in moral issues. This is one of the areas of concern of physics education.

There are many physics students in secondary schools who are unclear of what they value or consider important. The Nigeria's National Policy on Education NPE (2008) expects that the quality of physics instruction in schools should orient students towards inculcating six values stated:

i. Respect for the work and dignity of the individuals
ii. Faith in man's ability to make rational decisions
iii. Moral and spiritual principles in inter-personal and human relations
iv. Shared responsibility for the common good of the society.
v. Promotion of the physical, emotional and psychological development of all children, and
vi. Acquisition of competencies necessary for self-reliance.

A critical examination of above value shows moral development concern for respect, faith, moral and spiritual relationship, sharing, growth and development, and competency. The pathetic issues in the Nigerian scene is that these values are more "lip serviced and window-dressed" than actualized. This explains why virtually nothing is done to follow the provisions to the letter by way of funding for teaching-learning needs and effectiveness. The scientific attributes of physics education have high promise to moral development of learners and adults, especially in Nigeria that there is a challenge of admixture of juvenile and largely adult delinquencies. Such attributes as humility, suspending judgment, tenacity, rationality, skepticism, open-mindedness, honesty, objectivity, patience and perseverance, where properly and painstakingly inculcated in learners in intrinsically and extrinsically motivated physics-learning environment, can bring about the desired multicultural, multi-presentational, multisensory and multi-perspective change in value system.

One such leading moral value component is integrity, which serves as an outward manifestation of all these scientific attributes. Integrity therefore is a moral value virtue which a person manifests the quality of honesty and belief on what is right. It is lamentable that Nigerian educational institutions are fast-becoming centres of immorality, given the myriad of vices that plaque these institutions. Sesay (2014) describes integrity as the cornerstone of ethical and moral conducts. The question now is: how much integrity do the physics teacher trainers and trainee have?

It is noted that physics teachers with integrity do what is right, stand up and take responsibility for their actions despite an earring multitude, whether at personal, civic, workplace and professional lives. Scientific attributes of physics education can contribute to making learners and adult persons possess integrity.

This can be obtained from honest reporting of experiments, humility in knowing that what is ever known is a very little of the universe of things to be known, and fairness as in the taking of scale, plotting of graph and considering the line of best-fit. Anyone who stands for integrity is brave by consistently insisting on completing an experiment to arrive at the result or outcome no matter how long. This is fuelled by inculcating the attribute of tenacity. Directing efforts to internalize these attribute, though slow, can be effective, both within and outside school lives.

SUMMARY

This work is concluded by noting that internalizing the scientific attributes of physics education can lead to reforming, transforming and morally developing youths and adult persons to cope with life and living in a receding or depressed economy, such as in Nigeria today.

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