ACCESSING THE QUALITY AND BENEFITS OF PHYSICS DISCOVERIES IN IMPROVING SCIENCE EDUCATION FOR THE BETTERMENT OF MAN IN NIGERIA

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Abstract

Physics is one of the core subjects of Science education that has made a tremendous impact in our modern society. The discoveries of electricity, X-ray, radiation, gravity etc have made our daily activities a comfortable one. This paper identified and accessed the quality of some of these discoveries and how their applications can improve the life of Nigerians through the teaching of science education.Certain recommendations such as government's support in developing science education and technology infrastructure, government and private investment in renewable energy industry, provision of relevant laboratories were suggested among others arethe solutions proffered.

Keywords: Physics, Science education, discoveries etc.

Physics cover a whole realm of scientific knowledge alternatively called natural philosophy. However, in the course of time when different aspects of scientific study of nature increased tremendously, many of the areas of specialization of physics which we know today sprang up. These specialized areas of physics include Solid State Physics, Laser Physics, Chemical Physics, Mathematical Physics, Astrophysics, Biophysics, Agro-physics, Nuclear and Atomic Physics. These and other branches of physics have made significant impact on our lives and contributed to the development of modern civilization (Sinh, Singh and Kaur, 2013).

Physics is the most fascinating of all scientific fields. It is the branch of science concerned with the nature and properties of *matter and energy* and the relationships between them. Physics provides deeper understanding of the world's natural processes using fundamental laws and mathematics.

Man's ability to discover the world in which he finds himself is made possible as a result of his good control over nature by his mastery of matter and energy. Some of the elementary physical properties of matter include mechanics , heat, light and other radiations, sound, electricity, magnetism, and the structure if atoms each with its own characteristics form of energy. Everything around us uses energy in one way or the other. The magic of the physicist therefore lies in his or her ability to convert energy from one form to another realizing that in any physical process, the overriding principle is that of the conservation of the total energy. For instance, the famous Italian physicist Alessandro Volta in 1799 stumbled at the discovering of electricity simply from the process of converting chemical energy to electrical energy by placing a piece of cloth soaked in brine between copper and zinc plates, an arrangement known as a *voltaic cell*. This is one of thegreatest discoveries in the history of man because of the way electricity has transformed our lives today (Cross, 1992).

Physicists strive for inexhaustible curiosity and passion for knowledge of the laws of nature in their great and small evidence. Physicists also demonstrate their ability apply their physical knowledge to the problems of principal importance when the need arises. A good example is the German-born American physicist, Hans Bethe (1942). During the period of Second World War, Hans

Be the first applied his knowledge of electromagnetic theory of radar problems in M.I.T. Radiation Laboratory, United States of America (USA), and concluded his war work at Los Almos National Laboratory also in USA.

Hans Bethe and his fellow physicists in Los Almos National Laboratory also solved an important problem in space exploration. When a spacecraft re-enter the Earth's atmosphere on its return journey from space, enormous amount of heat is generated (about 3000 degree Celcius) because of the friction between the spacecraft and the atmosphere as a result of the space craft which is travelling at about 17,500 miles per hour (28, 000km/h) slowing down to about 500 miles per hour (800km/h) on re-entry. The problem was to find a suitable material that absorbs much energy without melting away which can be used as heat shield (called insulating tiles or heat foam) that protects the spacecraft from burning up on re-entry. Hans Bethe and his colleagues were able to solve the problem by assuming that the viscosity of such a material is not constant, but the most rapidly variable function of position (which is against the usual assumption of the aero dynamists, namely that viscosity is constant). As a result of these and other problems he solved in physics such as calculating the "critical mass" that sustains a chain nuclear reaction in atomic bomb, Hans Bethe was called the "supreme problem-solver of the 20th century" by one of his former students, Freeman Dyson. Hans Bethe was awarded the 1967 Noble Prize in Physics for his broad and versatile contributions which he made to almost every branch of physics.

One would also want to mention here the novel quantum theory that developed from the researches of another German physicist, Max Planck in the 1900s that revolutionalized the human understanding of atomic and subatomic processes. Before this period, some phenomena in physics such as photoelectric effect, the Compton Effect, the specific heats of solids, and the structure of atoms and molecules could not be explained using the classical theory existing then. However, with the wave – particle duality of matter (waves behaving like particles and vice versa) which arose from Plank's quantum theory, scientists were now able to give satisfactory explanation to these and other phenomena in physics which undoubtedly expanded the frontiers of our scientific knowledge. Max Plank received the Noble Prize in physics in 1918 for his "discovering of quanta" a postulation – that electromagnetic energy is absorbed or emitted in discrete packets called quanta which was his attempt to bring experiment into agreement with theory (Barrow, 1986).

Physics Discoveries in Improvising Science Education for the Betterment of Man

Physics is the bedrock of all technologies. The discoveries and inventions of men and women of physics for which some of them received the Noble Prize have had profound impact in the field of medicine, agriculture, transportation, communication, scientific research, etc. Let's consider some examples:

(i) **X-rays** discovered by the German physicist, Wilhelm Roentgen in 1895 for which he was awarded the first Noble Prize in Physics in 1901 are widely used in medicine to locate bone fracture, detect foreign bodies in airport to check luggage, etc. They are also used in the industry to detect cracks and flaws in metal casting and welded joints.

(ii) **Radioactivity** discovered in 1896 by the French physicist, Henri Becquerel has found useful applications in agriculture, medicine, industry and scientific research. Radioactive elements are used in agriculture to induce mutations in plants to obtain new improved varieties. In the industry, radioactive elements are used to study the defects in metals and welded joints, and to check metal fatigue. Henri Becquerel shared the 1903 Noble Prize in Physics with two other French Physicists, namely Pierre Curie and Marie Curie for their pioneering research on radioactivity, especially for their discovery of radioactive elements, radium and polonium.

(iii) From late 1800s to early 1900s, two physicists, Guglielmo Marconi of Italy and Ferdinand Braun of Germany pioneered the work on wireless transmission in the field of communication and contributed to the development of radio and television technology. In particular, Ferdinand Braun invented the cathode-ray tube (CRT) in 1897 that would become the primary electronic display device for radar, television, and computer until the end of the 20th century, when flat-screen technologies

were introduced. For their groundbreaking achievements, Marconi and Braun jointly received the 1909 Nobel Prize in Physics.

(iv) **Superconductivity** discovered by the Dutch physicist, Heike Kammerlingh-Onnes in 1911 for which he was awarded the Nobel Prize in Physics in 1913 is used in magnetic resonance imaging (MRI) machine in healthcare, high-performance electric motors for ship propulsion and magnetic levitated (Maglev) train in transportation. It is also used as microwave devices in mobile communication and modern radar systems and in radio/TV broadcasting industry. Its promising future applications include superconducting fast switches in computer, high-performance transformers, power storage devices and electric power transmission.

(v) In 1905, Albert Einstein, a German-born theoretical physicist of Jewish parents in his **Special Theory of Relativity** proposed that the laws of physics are the same of all inertial frames of reference (non-accelerating observers), and that the speed of lights is the same for all observers. As part of his theory, Einstein made the intriguing point of matter. This was expressed in his famous equation, $\mathbf{E=mc^2}$ (energy = mass x the speed of light squared). Einstein's equation is regarded as the most important scientific discovery of the 20th century. This equation is involved in all energy releases in our everyday life whenever there is a change of mass, however, slightly.Einstein's $E=mc^2$ unlocks the immense power of the atom in using nuclear energy (atomic energy) either for the benefit of man such as producing electricity and providing healthcare or for creating weapons of mass destruction as in atomic bomb.

In 1916, Albert Einstein also produced the **General Theory of Relativity-**a theory which describes how mass and space are related to each other and states that matter can bend and wrap the fabric of space and time due to the effect of gravity. The Global Positioning System (GPS), a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth surface is a consequence of Einstein's General Theory of Relativity. Today, we have GPS on our phones and in our cars which would not have been possible without this theory. For his contributions in many fields of physics especially in the area of quantum mechanics, Albert Einstein won the 1921 Noble Prize in Physics and later became the world personality of the second millennium.

(vi) The invention of the transistor (a device for the amplification or boosting of electrical signals) in 1984 by three American physics, namely John Bardeen, Walter Brattain and William Shockleyfor which they were jointly awarded the 1956 Nobel Prize in Physics gave birth to semiconductor devices that revolutionized the electronic industry.

(vii) **Holography**invented by Dennis Gabor of Hungary in 1948 for which he was awarded the Nobel Prize in Physics in 1971 is a 3-D lenseless method of photographic beam combiner which is at the heart of head-up display in an aircraft, a device which allows aircraft pilot a virtually unimpeded view of the outside world, with computer information clearly superimposed upon it.

(viii) The **Laser** developed in 1951 by three physicists, namely Charles Townes of USA, Alexander Prokhorov of Australia and Nicolay Basav of Russia for which they jointly received the Nobel Prize in Physics in 1964 is a device that produces an intensive, concentrated and highly parallel beam of coherent light. Lasers are used by surveyors and engineers for critical alignment and in the industry to cut through diamond and steel plates. Lasers are also used in medicine for surgery, where retinal tissue is cauterized to weld detached retinas.

(ix) In early 1970s a British physicist Sir Peter Mansfield and an American chemist Paul Lanterbur made seminal discoveries concerning the use of magnetic resonance to visualize different structures which led to the development of Magnetic resonance imaging (MRI)-a technique that is used to carry out medical examination in the Medicine or Physiology.
Also in the field of medicine, a Nigerian Professor of Physics AbimbolaLaogun, formerly of the University of Benin and a British scientist, Raymond Gosling developed between 1982 and 1990 a method for monitoring the degree of involvement of blood vessels in atherosclerotic disorders such as

diabetes mellitus and sickle-cell anemia as well as testing the efficacy of drugs used in their management by applying two major physics techniques of **dielectric spectroscopy** and **the continuous wave Doppler – shift ultrasonic system.** This method is now favourably in use in hospitals and medical centres in different parts of the world.

(x) In the field of Information and Communication Technology (ICT), three physicists, ZhoresAlferov of Russia, HerbetKromer of Germany and Jack Kilby of USA were jointly awarded the 2000 Nobel Prize in Physics for their work that laid the foundation of modern information technology (IT), particulary by their invention of rapid transistors and laser diodes (ZhoresAlferov and Herbert Kromer) and the integrated circuits (Jack Kilby) that brought another big revolution to the electronic industry.

(xi) In the area of ICT, the 2009 Nobel Prize in Physics was jointly received by three physicists, namely Willard Boyle of Canada and George Smith of USA for their invention of an imaging semiconductor device, the CCD (Charge-Coupled Device) sensor and Charles Kao of China for groundbreaking achievements concerning the transmission of light in optical fibres in communication. Optical fibre cables have replaced copper cables previously used in telecommunications. Optical fibre cables are also used to make remote viewing system for medical and other purposes where access to the scene is restricted.

(xii) The 2013 Nobel Prize in Physics was jointly awarded to Peter Higgs of Britain and Francois Englert of Belgium, two physicists who in 1964 predicted the existence of the sub-particles, the Higgs boson. This prediction was confirmed in 2012 by experiments at the Large Hadron Collider (LHC) the world's largest and most powerful particle collider which is part of CERN's particle accelerator complex (the European Centre for Nuclear Research), based in Geneva. Switzerland. Scientists believe that the Higgs boson, which they call "God particle" could unlock some of the universe's deepest secrets.

(xiii) The 2014 Nobel Prize in Physics was jointly received by three Japanese, namely Isamu Akasaki, Hiroshi Amano and Shuji Nakamura for their invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources.

(xiv) The 2016 Nobel Prize in Physics went to three British physicists, namely Michael Kosterlitz, DucanHaldone and David Thoutes for theoretical discovering of topological phase transmissions and topological phases of matter. Their discoveries show that under certain conditions some materials could easily conduct electrons along their surface, but remain an insulator within. Most importantly, they discovered cases where matter transitioned between states without breaking something called symmetry, as happens when water atoms rearrange into ice or vapor. One recent practical application of the newly found phase of matter-topological insulator is shrinking an electrical component called circulator 1,000 times smaller which is super good news when it comes to squeezing more qubits (quantum bits of 0 and 1) into a small space. Such compact insulators could be implemented in a variety of quantum hardware platforms. The news is that it won't be long we will be having quantum computers that may be to effectively solve problems which are not *practically* feasible in our present computer.

(xv) The 2017 Noble Prize in Physics was jointly awarded to three Americans, namely Emeritus physicist Rainer Weiss, Barry Barish and Kip Thorne for their First direct detection of gravitational waves-ripples in fabric of space-time caused by massive bodies' gravitational pull whose existence was first proposed by Albert Einstein in 1916 in his General Theory of Relativity. According to scientists, this detection will give humanity the ability to see the universe in a totally new way. For instance, gravitational waves have the potential to show scientists totally new features of cosmic objects such as asteroids, black holes, comets, meteors, planet and stars.

Science education deals with sharing of science content and process with individuals who are not considered traditionally to the member of the scientific community; the individuals could be students, farmers, market women or a whole community. Science education in Nigeria concentrates

on the teaching of science concepts, methods of teaching and addressing misconceptions held by learners regarding science concepts.

Science education comprises three subject namely biology, chemistry and physics and physics which are combined with education. A graduate of physics can be self employed as opined by many of the physics graduates have some knowledge of electronic that is enough for them to be able to have a little period of training as apprentices and then stand alone as electronic technician. For instance, semiconductor is very important in the modern technology that if properly learnt it is enough for one to stand upon for a living; semiconductor physics is part of what any graduate in physics will learn and should learn. In semi conductor, it is very important in a growing economy like ours in Nigeria; it is useful in ceramic industry and a well trained physics education graduate can be well established in ceramic industry.

Without science education Information and Communication Technology would be impossible. Science and technology without science education' for instance engineering, medicine.

Conclusion

Discoveries in Physics have played a major role in the development of modern civilization. Applications of these discoveries in divers area such as agriculture, communication, electric power systems, transportation and others have led to increase in food production , better communication systems that has made the world a global village, improvement in our healthcare delivering system, creating safer and more enjoyable means of transportation and the like. This has improved the teaching of science education in Nigeria.

Recommendations

1. **Government's support in developing science and technology infrastructure:** Science is the basis for Technology and one of the parameters of evaluating the development of a nation is its level of technological development. It is important therefore for government to commit a significant percentage of its annual budget to the development of science and technology, especially in the area of research and development (R&D).
2. **Government and Private Sector Investment in Renewable Energy Industry (solar Energy):** With the high environmental cost of conventional energy sources and the finite supply of fossil fuels such as oil, gas and coal (non-renewable energy sources), the importance of renewable energy sources has become much more apparent in recent years. The Sun stands out as an ideal replacement for fossil fuels resources. Many people are now embracing solar power (energy from the sun) as alternative and reliable source of energy.
3. **Developing sustainable Nuclear Energy in the Country:** Nigeria should also explore the option of nuclear power in its energy mix for it to boost its installed electricity generating capacity which will enhance its socio-economic development.
4. **Nigerian physicists and science educators** should be adequately represented in the planning and implementation of all aspect of Science education and technologycurricula in Nigeria.

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