Emerging Technologies and the Internet of all Things: Implications for Nigeria's higher education curricular

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Abstract

The quality of education and graduates emerging from a country's educational system is a catalyst for technology innovation and national development index. World class universities are showcasing their innovations in science and technology because their high education curricular put the future of Research and Development as their pillar for a brighter world. Our curricular in the higher education system needs a rethink, recasting to embrace innovation, design and production at the heart of what our new generation graduates should be. This article discusses an array of such emerging technologies. Because emerging technologies in all sectors are over 150. we had decided to select three key technologies from each sector for our sample questionnaire. A questionnaire was distributed mainly to educational planners, Lecturers and managers of the industry for purposes of having a feel of how knowledgeable these professionals are understanding developments in science technology and what plans they have to integrate these new knowledge domains so that educational planners can integrate them into the curricular of undergraduate and graduate degree programs in our tertiary institutions. Five research questions were posed with three null hypotheses tested. The findings are startling – our planners have just a handful knowledge of these developments in science and technology. Thus, it was concluded that part of problem with our educational systems does lie in this domain – the lack of robust exposure to the world of technology. However, it is aggreable that the curricular developed for our tertiary institutions are not balanced and therefore affects the quality of graduates of Nigeria's tertiary institutions. The paper recommended that the syllabi of courses run in our tertiary institutions should be re-visited, recast and unified with the future as key component of the new curricular for the good of Nigeria. It also recommended the removal of demotivators for researchers such as poor remuneration and consequent loss of dignity by improved remuneration comparable to those in advanced or industrializing economies of the new world. Educational planners and teachers must be retrained regularly on the emerging technology trends to improve their skills in curriculum architecturing.

1.0 Curriculum formulation in higher institutions and Need for integration of the future in curriculum planning

Wikipedia has defined ***curriculum*** as the planned interaction of pupils with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives. It includes all the learning planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school. Curriculum outlines the skills, performances, attitudes, and values pupils are expected to learn from schooling. It also includes statements of desired pupil outcomes, descriptions of materials, and the planned sequence that will be used to help pupils attain the outcomes [202][203][204][205]..

Higher education must be sustainable. Education for Sustainable Development (ESD) is the practice of teaching for sustainability and used internationally by the United Nations. According to [227] the skills below are necessary for higher education sustainability – being able to imagine a better future because if we know where we want to go, we shall be better able to work out how to get there. It requires critical and systematic thinking and reflection, i.e. learning to question our current belief systems and to recognize the assumptions underlying our knowledge, perspective and opinions. Systematic thinking involves acknowledging complexities and look out for links and synergies when solution attempts to problems are made. It also requires building partnerships by promoting dialogue and negotiation, i.e collaborative learning and by empowering people via participation in decision-making [201].

1.1 Impact of quality graduates on national development

From a pragmatic functionalist sociological perspective, we observe that society is one ***interconnected entity.*** Given this interconnectedness, each branch affects all other branches of the entity. One key to ensuring the Nigerian Dream for all is ***education***. Education is a central component of any nation's developmental process and for it to facilitate this function, the process should be clearly defined, legislatively protected from any political dictates, owned by relevant stakeholders, adequately financed and constantly subjected to periodic technical consultations and reviews to ensure that it is in harmony with both local and global needs. For this to be realized, it is essential that a fundamental theory of education is conceived. From these theories, one may derive a ***pedagogy of hope***, and empowerment that is essential for development. This requires going beyond the myth of traditional pedagogy. ***Pedagogy of hope*** will place great emphasis on both the ***creative and dialogical dimensions*** **of education** that utilize technological advances that are essential for societal growth. Thus, it is expected to assume the ***presence of an acting person***, one who constructively acts upon problematic situations, and who thereby **creates a new world and a new hope**. Pedagogy of hope is expected to transform the learner into a problem-solving agent, a creator rather than a creature. To this end, the education process must go beyond mere transmission of factual knowledge. Instead, educators must present knowledge, skills and values that are liberating in as far as they create new horizons and opportunities that are vital for development. The learners too must

become critically aware of their potential as humans, of their power to use circumstances rather than being used by them. This requires a paradigmatic shift in the conceptualization and management of the education process. For this to be effective the education process must be multi-dimensional and should encompass cognitive and a normative dimensions. Education is a vital tool in the developmental process of any given nation. This paper, in a summary, is suggesting that there is a strong correlation between quality education and national development. Thus, in order for education to foster development, it is recommended that educational policies be separated from national politics [206].

The existing malaise in our tertiary institutions symphonizes poor quality curricular which is manifested in the inability of Professors and lecturers to innovate and create new technologies from their sound pedagogical foundations in the ivory towers. The absence of innovation in science and technology is holding back Nigeria's development.

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2.0 Materials and Methods

2.1 Emerging Technologies today: need to integrate these knowledge Domains into our curricula[1]

Sectoral Breakdown of Emerging Technologies

Emerging Technologies have been structured into 13 knowledge domains and organized into alphabetical order with a brief explanation of the meaning of each technology chosen for the research, application areas and the likely technology it is going to replace. Sectors covered include: *agriculture and agricultural technology, Biomedical sciences, Display technology, Electronics, Energy InformationTechnology, Manufacturing, Material Science, Military and warfare, Neuroscience, Robotics, Transport technology and Other emerging technologies*.

For the purpose of this research three sample knowledge domains were selected from each of the ten areas, save for "Others" which attracted ten questions. Each respondent was asked to rate his or her knowledge of the selected emerging technology "Y" for Yes denoting that he has some idea of the technology and "N" for No indicating that the emerging technology is not known to him. The essence of this questionnaire is to answer the research questions and hypotheis which sought to know if our educational planners are aware of global technology trends that can assist them in buiding a sound curricular with the future in focus. This was followed by open "yes" or "no" questions on issues bordering on the unemployability of **Nigeria graduates due to poor skill acquisition, the need to** rethink, restructure, embellish and unify existing higher education curricular, the impact of poor budgetary allocation on Research, Innovation and Development (RID) and the consequences of non-innovative instinct and culture in the ivory tower. The choice of Technologies for the test is scheduled in Table 1 below.

Accordingly, we chose to define only the selected emerging technologies and leaving the rest undefined to minimize space and volume. The references on each emerging technology is indicated in square bracket and appear in the reference list at the end of this article.

Agriculture and Agricultural Technology

1. Closed Ecological Systems: Closed ecological systems (CES) are ecosystems that do not rely on matter exchange with any part outside the system[2].

2. Genetically modified food *[3]*

3. Meat incubator

4. In vitro meat *[4]*

5. ***Precision agriculture***: Precision farming (PA) or satellite farming or site specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops[5].

6. **Vertical farming** [6]

***Agricultural Robot*:** An agricultural robot or agribot is a **robot** deployed for **agricultural** purposes [7]. Examples include Ag Ant", an inexpensive foot-long bot that works cooperatively, The Oracle Robot

Biomedical

1. Artificial uterus: An artificial uterus (or womb) is a theoretical device that would allow for extracorporeal pregnancy, growing an embryo or fetus outside the womb. **It is an artificial womb.** Wekipedia describes it as a theoretical device that would allow for extracorporeal pregnancy or extrauterine fetal incubation (EUFI) [8]

2. ***Body implants prosthesis***: An artificial device used to replace a missing body part, such as a limb, tooth, eye, or heart valve. Thus, it is the replacement of a missing body part with such a device. [9] The Free Medical Dictionary defines it as "an object or material inserted or grafted into the body for prosthetic, therapeutic, diagnostic, or experimental purposes"[10] while Wikipedia renders it as "an artificial device that replaces a missing body part lost through trauma, disease, or congenital conditions"[11].

3. Cryonics : *Wikipedia has defined Croyonics as the low-temperature preservation of humans and animals who cannot be sustained by contemporary medicine, with the hope that healing and artificial resurrection or resuscitation may be possible in the future [12]*

4. Expressive augmentationGenetic \ *engineering* *[13]*

5. Hibernation or suspended animation [14].

6. Life extension, strategies for engineered neglible senescence [15]

8. Nanomedicine [16]

9. Oncolytic Virus *[17]*

10. Personalized medicine, full genome sequencing [18]

11. ***Regenerative medicine [****19]*

12. Robotic surgery [20].

13. *Stem cell treatments [21*]

Table 1: choice of Emerging Technologies used in the Test		
Knowledge Sector	***Emerging Technology***	***Choice (Y/N) Y = have some Faint knowledge of the Technology = 1. N = no idea - 0***
1. A griculture science and technology	a. Agricultural Robot b. Closed ecological Systems c. Precision Agriculture	[Y/N] [Y/N] [Y/N]
2. Biomedical Technology	a. Artificial uterus b. Body implants, Prosthesis c. Cryonics	[Y/N] [Y/N] [Y/N]
3. Display Technology	a. Holographic Displace, Computer- generated holography b. Phased-array optics c. Screenless display	[Y/N] [Y/N] [Y/N]
4. Electronics	a. Electronic nose b. Spintronics c. Thermal copper pillar bump	[Y/N] [Y/N] [Y/N]
5. Energy	a. Vortex engine b. Artificial photosynthesis c. Hydrogen economy	[Y/N] [Y/N] [Y/N]
6. IT and Communications	a. Ambient intelligence b. Artificial brain c. Machine translation	[Y/N] [Y/N] [Y/N]
7. Manufacturing	a. Claytronics b. Molecular assembler c. Utility fog	[Y/N] [Y/N] [Y/N]
8. Material Science	a.	
9 Military and Warefare	a. Caseless ammunition b. Electrothermal-chemical technology c. Sonic weapon	[Y/N] [Y/N] [Y/N]
10. Neurosciences	a. Brain-reading Neuroinformatics b. Electroencephalography c. Neuroprosthetics	[Y/N] [Y/N] [Y/N]
11. Robotics	a. Molecular Nanotechnology - Nanorobots b. Powered exoskeleton c. Swarm robotics	[Y/N] [Y/N] [Y/N]
12. Transport	a. Alcubierre drive b. Driverless car	[Y/N] [Y/N]

	c. Flying car	[Y/N]
13. Others	a. Cloak of invisibility b. Technological singularity c. Internet of all things d. Mobile devices without battery e. Domed city f. Immersive virtual reality i. Synthetic genomics j. Asteroid Mining k. Arcology l. Bioplastic m Anti-gravity	[Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N]

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13. ***Tissue engineering*** *[22].*
14. ***Virotherapy*** *[23].*
15. ***Vitrification*** *[24].*
16. ***Cryoprotectant*** *[25]*

Displays

1. ***3D displays***
2. ***Ferro Liquid Displays*** *[26]*
3. **Field emission display** [27].

4. Holography (Holographic display, computer-generated holography):
Holography is a technique which enables three-dimensional images to be made. It involves the use of a laser, interference, diffraction, light intensity recording and suitable illumination of the recording. The image changes as the position and orientation of the viewing system changes in exactly the same way as if the object were still present, thus making the image appear three-dimensional. The holographic recording itself is not an image; it consists of an apparently random structure of varying intensity, density or profile [28].

6. **Interferometric modulator display** [29].
7.
8. OLED displays [30].Laser video displays **[31].**
9. **Organic light-emitting transistor** [32]
10. **Phased-aray optics**: **Phased array optics** (PAO) is the technology of controlling the phase of light waves transmitting or reflecting from a two-dimensional surface by means of adjustable surface elements. It is the optical analog of phased array radar. By dynamically controlling the optical properties of a surface on a microscopic scale, it is possible to steer the direction of light beams, or the view direction of sensors, without any moving parts [33].

11. ***Datum dot display*** ***[34].***
12. ***Screenless display (Virtual retinal display, Bionic contact lens)****:* It refers to the display of several things without the use of screens using projector. It involves the following 3 different working principles. The Visual image, Virtual retinal display, and Synaptic interface [35].

13. Surface-conduction electron-emitter display **[36].**
14. Telescopic pixel display *[37]*.
15. Thick-film dielectric electroluminescent technology [38].
16. *Volumetric display* ***[39].***

Electronics

1. Electronic nose: An **electronic nose** is a device intended to detect odors or flavors. Over the last decade, "electronic sensing" or "e-sensing" technologies have undergone important developments from a technical and commercial point of view. The expression "electronic sensing" refers to the capability of reproducing human senses using sensor arrays and pattern recognition systems [40].
2. ***E-textiles*** *[41]*.
3. Flexible electronics [*42]*.
4. Memristor [43].
5. Spintronics: *Spintronics (a portmanteau meaning "spin transport electronics"), also known as magnetoelectronics, is an emerging technology exploiting both the intrinsic spin of the electron and its associated magnetic moment, in addition to its fundamental electronic charge, in solid-state devices [44]*.
6. Termal copper bumb: The thermal copper pillar bump, also known as the "thermal bump", is a thermoelectric device made from thin-film thermoelectric material embedded in flip chip interconnects (in particular copper pillar solder bumps) for use in electronics and optoelectronic packaging, including: flip chip packaging [45].

Energy

1. **Vortex engine**: The concept of a **vortex engine** or **atmospheric vortex engine** (**AVE**), independently proposed by Norman Louat and Louis M. Michaud, aims to replace large physical chimneys with a vortex of air created by a shorter, less-expensive structure. Michaud's patent claims that the main application is that the air flow through the louvers at the base will drive low-speed air turbines [21], generating twenty percent additional electric power from the heat normally wasted by conventional power plants [46].

2. **Airborne wind turbine**. [47].
3. Artificial Photosynthesis: **Artificial photosynthesis** is a chemical process that replicates the natural process of photosynthesis, a process that converts sunlight, water, and carbon dioxide into carbohydrates and oxygen.[48].
3. ***Biofuels*** *[49]*.
4. Concentrated solar power [50]
5. ***Electrical double-layer capacitors (EDLC*** *[51]*.

5. ***Flywheel energy storage***: **Flywheel energy storage** (**FES**) works by accelerating a rotor (flywheel) to a very high speed and maintaining the energy in the system as rotational energy. When energy is extracted from the system, the flywheel's rotational speed is reduced as a consequence of the principle of conservation of energy; adding energy to the system correspondingly results in an increase in the speed of the flywheel. [52].
6. ***Generation IV Reactor*** *[54]*.
7. Grid energy storage *[55]*.
7. Home fuel cell *[56]*
8. ***Hydrogen economy***: The **hydrogen economy** is a proposed system of delivering energy using hydrogen. The term *hydrogen economy* was coined by John Bockris during a talk he gave in 1970 at General Motors (GM) Technical Center. Hydrogen advocates promote hydrogen as a potential fuel for motive power (including cars and boats), the energy needs of buildings and portable electronics [57].
9. Lithium iron phosphate battery *[58]*.
10. Molten salt battery *[59]*. *[60]*.
11. Nanowire battery *[61]*.
12. Nantenna *[61]*.
13. Silicon-air battery *[62]*.

14. Smart grid *[63]*.
15. Solar roadway *[64]*.
16. Space-based solar power *[65]*.
17. Thorium fuel cycle*. [66]*.
18. Wireless energy transfer *[67]*.
19. Energy harvesting *[68]*.
20. Fusion power*[69]*

Information Technology

1. ***4G cellular communication*** [70].
2. *Ambient intelligence*: In computing, ambient intelligence (AmI) refers to electronic environments that are sensitive and responsive to the presence of people. Ambient intelligence is a vision on the future of consumer electronics, telecommunications and computing that was originally developed in the late 1990s for the time frame 2010–2020. In an ambient intelligence world, devices work in concert to support people in carrying out their everyday life activities, tasks and rituals in an easy, natural way using information and intelligence that is hidden in the network connecting these devices. As these devices grow smaller, more connected and more integrated into our environment, the technology disappears into our surroundings until only the user interface remains perceivable by users.
3. *Artificial brain:* Also called artificial mind it is a term commonly used in the media to describe research that aims to develop *software and hardware* with cognitive abilities similar to those of the animal or human brain [72].
4. Artificial intelligence *[73]*.
5. Atomtronics *[74]*.
6. Augumented Reality*[75]*.
7. Emerging memory technologies T-RAM, Z-RAM, TTRAM, CBRAM, SONOS, RRAM *[76]*.
8. Racetrack memory, NRAM, Millipede memory *[77]*.
9. Forth-generation optical discs (3D optical data storage, Holographic data Storage [78].
10. **General-purpose computing on graphics processing units** [79].
11. Machine augmented cognition, exocortices [80].

12. Machine translation: This implies the use of computers to translate from one language to another. **Machine translation**, sometimes referred to by the abbreviation **MT** (not to be confused with **computer-aided translation**, **machine-aided human translation (MAHT)** or **interactive translation**) is a sub-field of computational linguistics that investigates the use of software to translate text or speech from one natural language to another [81].

13. Machine vision [82].
14. Mobile collaboration [83].
15. **Optical computing** [84].
16. Quantum computing [85].
17. Quantum cryptography [86].
18. **Radio-frequency identification** [87].
19. **Semantic Web or answer machine** [89].
20. Speech recognition [90].
21. **Three-dimensional integrated circuit** [91].
22. **Virtual Reality** [92].
22. Internet of all Things (IAT [93].
23. **Technological Singularity** [94].
24. **Communicating with mobile digital devices without battery** [95].

Manufacturing

1. *3D Printing*: Additive manufacturing or 3D printing [96].

2. *Claytronics*: Claytronics is an abstract future concept that combines *nanoscale* robotics and *computer science* to create individual nanometer-scale computers called claytronic atoms, or catoms, which can interact with each other to form tangible 3-D objects that a user can interact with. This idea is more broadly referred to as *programmable matte*r.

Claytronics has the potential to greatly affect many areas of daily life, such as telecommunication, human-computer interfaces, and entertainment [97].

3. **Molecular assembler:** A **molecular assembler**, as defined by *K. Eric Drexler*, is a "proposed device able to guide chemical reactions by positioning reactive molecules with atomic precision". A molecular assembler is a kind of *molecular machin*e. Some biological molecules such as *ribosomes* fit this definition. [98].

4. **Utility fog: Utility fog** (coined by Dr. ***John Storrs Hall*** in 1993) is a hypothetical collection of tiny robots that can replicate a physical structure. As such, it is a form of self-reconfiguring modular robotics. [99]

Materials Science

1. ***Aerogel***: Aerogel is a synthetic porous ultralight material derived from a gel, in which the liquid component of the gel has been replaced with a gas. The result is a solid with extremely low density and low thermal conductivity. Nicknames include "frozen smoke", "solid smoke", "solid air" or "blue smoke" owing to its translucent nature and the way light scatters in the material [100].

2. ***Conductive Polymers*: Conductive polymers** or, more precisely, **intrinsically conducting polymers** (ICPs) are organic polymers that conduct electricity. Such compounds may have metallic conductivity or can be semiconductors. The biggest advantage of conductive polymers is their processability, mainly by dispersion. Conductive polymers are generally not thermoplastics, *i.e.*, they are not thermoformable. But, like insulating polymers, they are organic materials. They can offer high electrical conductivity but do not show similar mechanical properties to other commercially available polymers 101].

3. ***Femtotechnology, Picotechnology*:** Picotechnology is a future Technology on the scale of trillionths of a metre (10^{-12}).This is orders of magnitude smaller than the nanotechnology.This technology is a future technology,and humans will achieve it in 22nd century.**Applications of picotechnology:**The structure and properties of individual atoms can be altered via the manipulation of energy states within electrons, to produce metastable states with highly unusual properties, creating new forms of exotic atoms. [102].

4. ***Graphene*** *[103]*.

5. ***High-temperature superconductivity*** *[104]*.

6. ***High-temperature superfluidity*** *[105] [106]*.

19. ***Metamaterials*** *[107]*.

20. ***Multi-function structure*** *[108]*.

21. ***Multifunctional Material Systems*** *[109]*.

22. ***Frontiers in Multifunctional Materials Technology*** *[110]*.

24. ***Nanomaterials*** *[111]*.

25. ***Programmable matter*** *[112]*.

26. ***Quantum dots*** *[113]*.

27. ***Silicene*** *[114]*.

Military and Warfare

1. ***Airborne laser [115].***

2. ***Antimatter weapon [116].***

3. ***Caseless ammunition: Caseless ammunition*** is a type of small arms ammunition that eliminates the cartridge case that typically holds the primer, propellant, and projectile together as a unit. Caseless ammunition is an attempt to reduce the weight and cost of ammunition by dispensing with the case, which is typically precision made of brass or steel, as well as simplify the operation of repeating firearms by eliminating the need to extract and eject the empty case after firing [117].

4. ***Directed energy weapon*** *[118]*.

5. ***Electrolaser*** *[119]*.

6. ***Electromagnetic weapons*** *[120]*.

7. ***Electrothermal-chemical technology: Electrothermal-chemical*** (ETC) technology is an attempt to increase accuracy and muzzle energy of future tank, artillery, and close-in

weapon system[1] guns by improving the predictability and rate of expansion of propellants inside the barrel.An electrothermal-chemical gun uses a plasma cartridge to ignite and control the ammunition's propellant, using electrical energy to trigger the process. [121].

8. ***Particle beam weapon*** *[122]*.

9. ***Plasma weapon*** *[12 3*].

10. ***Pure fusion weapon*** *[124]*.

11. ***Sonic weapon*****: Sonic and ultrasonic weapons** (USW) are weapons of various types that use sound to injure, incapacitate, or kill an opponent. Some sonic weapons are currently in limited use or in research and development by military and police forces. Others exist only in the realm of science fiction. Some of these weapons have been described as sonic bullets, sonic grenades, sonic mines, or sonic cannons. Some make a focused beam of sound or ultrasound; some make an area field of sound [125].

12. ***Stealth technology*** *[127]*.

Neuroscience

1. ***Abolition of Suffering*** *[128]*.

2. ***Ampakine*** *[129]*.

3. ***Artificial brain*** *[130]*.

4. ***Brain-computer interface*** *[131]*.

5. ***Brain-reading, Neuroinformatics*****: Neuroinformatics** is a research field concerned with the organization of neuroscience data by the application of computational models and analytical tools. These areas of research are important for the integration and analysis of increasingly large-volume, high-dimensional, and fine-grain experimental data. Neuroinformaticians provide computational tools, mathematical models, and create interoperable databases for clinicians and research scientists. Neuroscience is a heterogeneous field, consisting of many and various sub-disciplines (e.g., Cognitive Psychology, Behavioral Neuroscience, and Behavioral Genetics). [132].

6. ***Electroencephalography*****: Electroencephalography** (**EEG**) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp. [133].

7. **Neuroprosthetics** [134].

Robotics

1. ***Molecular nanotechnology, nanorobotics****:* Molecular nanotechnology (MNT) is a technology based on the ability to build structures to complex, atomic specifications by means of mechanosynthesis. This is distinct from nanoscale materials. Based on Richard Feynman's vision of miniature factories using nanomachines to build complex products (including additional nanomachines), this advanced form of nanotechnology (or molecular manufacturing) would make use of positionally-controlled mechanosynthesis guided by molecular machine systems. MNT would involve combining physical principles demonstrated by chemistry, other nanotechnologies, and the molecular machinery of life with the systems engineering principles found in modern macroscale factories [135].

2. ***Powered exoskeleton***: A **powered exoskeleton**, also known as **powered armor**, **exoframe**, or **exosuit**, is a mobile machine consisting primarily of an outer framework (akin to an animal's exoskeleton) worn by a person, and a powered system of motors or hydraulics that delivers at least part of the energy for limb movement.The main function of a powered exoskeleton is to assist the wearer by boosting their strength and endurance. They are commonly designed for military use, to help soldiers carry heavy loads both in and out of combat. In civilian areas, similar exoskeletons could be used to help firefighters and other rescue workers survive dangerous environments.[1] The medical field is another

prime area for exoskeleton technology, where it can be used for enhanced precision during surgery, or as an assist to allow nurses to move heavy patients [136].

3. ***Self-reconfiguring modular robot*** *[137]*.

4. ***Swarm robotics: Swarm robotics*** is a new approach to the coordination of multirobot systems which consist of large numbers of mostly simple physical robots. It is supposed that a desired collective behavior emerges from the interactions between the robots and interactions of robots with the environment. This approach emerged on the field of artificial swarm intelligence, as well as the biological studies of insects, ants and other fields in nature, where swarm behaviour occurs [138].

5. **Unmanned Vehicle** [139]

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Transport

1. ***Airless tire*** *[140]*.

2. ***Alcubierre drive*****:** The **Alcubierre drive** or **Alcubierre metric** (referring to metric tensor) is a speculative idea based on a solution of Einstein's field equations in general relativity as proposed by Mexican theoretical physicist Miguel Alcubierre, by which a spacecraft could achieve faster-than-light travel if negative mass existed. Rather than exceeding the speed of light within its local frame of reference, a spacecraft would traverse distances by contracting space in front of it and expanding space behind it, resulting in effective faster-than-light travel. [141].

3***.*** ***Alternative fuel vehicle*** *[142]*.

4. ***Beam-powered propulsion*** *[143]*.

5. ***Driverless car*****:** An **autonomous car**, also known as a **robotic car**, or informally as **driverless** or **self-driving**, is an autonomous vehicle capable of fulfilling the human transportation capabilities of a traditional car. As an autonomous vehicle, it is capable of sensing its environment and navigating without human input. Robotic cars exist mainly as prototypes and demonstration systems, but are likely to become more widespread in the near future. Autonomous vehicles sense their surroundings with such techniques as radar, lidar, GPS, and computer vision. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage [46].

6.. ***Hovertrain, Ground effect train*** *[147]*.

7. ***Ion thruster*** *[148]*.

8. ***Jet pack or backpack helicopter*** *[149]*.

9. ***Maglev train, Vactrain*** *[150]*.

10. ***Mass driver****. [151]*.

11. ***Personal rapid transit*** *[152]*.

12. ***Physical Internet*** *[153]*.

13. ***Propellant depot*** *[154]*.

14. ***Pulse detonation engine*** *[156]*.

15. ***Scramjet*** *[157]*.

16. ***Solar sail****. [158]*.

17. ***Space elevator****. [159]*.

18. ***Spaceplane****. [160]*.

19. ***Supersonic Transport*** *[161]*.

20. ***Nuclear lauch Cannon*** *[162]*.

21. ***High altitude Platoforms*** *[163]*.

22. ***Orion Nuclear Starship*** *[164]*.

23. ***Aeoroscraft*** *[165]*.

24. ***Float to Orbit*** *[166]*.

25. ***Hyperloop****. [167]*.

26. ***Flying car:*** A **flying car** is a hypothetical personal aircraft that provides door-to-door transportation (*e.g.,* from home to work or to the supermarket) as conveniently as a car and without the requirement for roads, runways or other specially-prepared operating areas. Such aircraft lack any visible means of propulsion (unlike fixed-wing aircraft or helicopters) so they can be operated at urban areas, close to buildings, people and other obstructions. The flying car has been depicted in fantasy and science fiction works such as *Chitty Chitty Bang Bang*, *Star Wars*, *Blade Runner*, *Back to the Future Part II* and *The Fifth Element* as well as articles in the American magazines *Popular Science*, *Popular Mechanics* and *Mechanix Illustrated*. [146].

Other emerging technologies

1. ***Anti-gravity***: **Anti-gravity** is the idea of creating a place or object that is free from the force of gravity. It does not refer to the lack of weight under gravity experienced in free fall or orbit, or to balancing the force of gravity with some other force, such as electromagnetism or aerodynamic lift [168].

2. ***Arcology*****: Arcology**, combining "architecture" and "ecology", is a set of architectural design principles for enormous habitats (hyperstructures) of extremely high human population density. These largely hypothetical structures would contain a variety of residential, commercial, and agricultural facilities and minimize individual human environmental impact. They are often portrayed as self-contained or economically self-sufficient. The concept has been primarily popularized, and the term itself coined, by architect Paolo Soleri, and appears commonly in science fiction [169].

3. ***Asteroid Mining*****: Asteroid mining** refers to the possibility of exploiting raw materials from asteroids and other minor planets, including near-Earth objects.[1] Minerals and volatiles could be mined from an asteroid or spent comet then taken back to Earth or used in space for space-construction materials. Materials that could be mined or extracted include iron, nickel, titanium for construction, water and oxygen to sustain the lives of prospector-astronauts on site, as well as hydrogen and oxygen for use as rocket fuel. In space exploration, using resources gathered whilst on a journey is referred to as in-situ resource utilization [170].

4. ***Atmospheric carbon dixoxide removal*** *[171]*.

5. ***Biometrics*** [172].

6. ***Bioplastic*****: Bioplastics** are plastics derived from renewable biomass sources, such as vegetable fats and oils, corn starch, pea starch or microbiota. Common plastics, such as fossil-fuel plastics, are derived from petroleum-these plastics rely more on fossil fuels and produce more greenhouse gas. Some, but not all, bioplastics are designed to biodegrade. Biodegradable bioplastics can break down in either anaerobic or aerobic environments, depending on how they are manufactured. There is a variety of materials that bioplastics can be composed of, including: starches, cellulose, or other biopolymers. Some common applications of bioplastics are packaging materials, dining utensils, food packaging, and insulation [173].

7. ***Cloak on invisibility*****:** A **cloak of invisibility** is a theme that has occurred in fiction, and is a device which is under some scientific inquiry. The **Cloak of Invisibility** is a magical artefact used to render the wearer invisible. [175].

8. ***Digital Scent technology*** *[177]*.

9. ***Doomed city: The Doomed City*** is a 1975 science fiction novel by Arkady and Boris Strugatsky, which is widely considered among the most philosophical of their novels. The name originates from an artwork by Nicholas Roerich which "astonished [the authors] a while ago with its gloomy beauty and the feeling of hopelessness radiating from it". [178].

10. ***Force field*** *[180]*.

11. ***Hypertelescope*** *[181]*.

12. ***Immersive virtual reality*****:** "Immersion" into virtual reality is a metaphoric use of the experience of submersion applied to representation, fiction or simulation. Immersion can also be defined as the state of consciousness where a "visitor" (Maurice Benayoun) or "immersant" (Char Davies)'s awareness of physical self is transformed by being surrounded in an engrossing environment; often artificial, creating a perception of Presence in a non-physical world. The term is widely used for describing partial or complete suspension of disbelief enabling action or reaction to stimulations encountered in a virtual or artistic environment. The degree to which the virtual or artistic environment

faithfully reproduces reality determines the degree of suspension of disbelief. The greater the suspension of disbelief, the greater the degree of Presence achieved [182] [197] [108] [199].

12. ***Internet of all Things*** **[IAT]:** For the industry, it is a paradigm shift. According to Helmuth Ludwig, CEO of Siemens Industry Sector of North America - the real manufacturing world is converging with the digital manufacturing world to enable organizations to digitally plan and project the entire lifecycle of products and production facilities [183]. Thus, in the factory of the future, everything is illuminated. It is gleaming white - a shining, interconnected web of information and production. The whole facility hums in quiet efficiency as smart machines collaborate with each other, with a global team of savvy workers, with customers and clients, intelligent analytics and dynamic systems all across the farthest extremes of the supply chain. [183].

13. ***The Singularity*****:** The **technological singularity**, or simply **the singularity**, is a theoretical moment in time when artificial intelligence will have progressed to the point of a greater-than-human intelligence that will "radically change human civilization, and perhaps even human nature itself." It is termed the period of exponential rise in intelligence. Since the capabilities of such an intelligence may be difficult for an unaided human mind to comprehend, the technological singularity is often seen as an occurrence (akin to a gravitational singularity) beyond which—from the perspective of the present — the future course of human history is unpredictable or even unfathomable. At the 2012 Singularity Summit, Stuart Armstrong did a study of artificial generalized intelligence (AGI) predictions by experts and found a wide range of predicted dates, with a median value of 2040. His own prediction on reviewing the data is that there's an 80% probability that the singularity will occur between 2017 and 2112 [184] [185] [186] [187] [193]. In his book, "the Singularity is Near", Kurzsweil has predicted a future time which he describes in his law of accelerating returns that there would be an exponential increase in technologies like computers, genetics, nanotechnology, robotics and artificial intelligence. He says this will lead to a technological singularity in the year 2045, a point where progress is so rapid it outstrips humans' ability to comprehend it. Irreversibly transformed, people will augment their minds and bodies with genetic alterations, nanotechnology, and artificial intelligence. Once the Singularity has been reached, Kurzweil predicts machine intelligence will be billions of times more powerful than all human intelligence combined. Afterwards, Kurzweil says, intelligence will radiate outward from the planet until it saturates the universe [195].

14. ***Mobile Devices without battery:*** **University of Washington** Engineers have created a new wireless communication system that allows devices to interact with each other without relying on batteries or wires for power. The new communication technique, which the researchers call 'ambient backscatter,' takes advantage of the TV and cellular transmissions that already surround us around the clock. Two devices communicate with each other by reflecting the existing signals to exchange information. The researchers built small, battery-free devices with antennas that can detect, harness and reflect a TV signal, which then is picked up by other similar devices [189] [190]. The research was funded by the University of Washington through a Google Faculty Research Award and by the National Science Foundation's Research Center for Sensorimotor Neural Engineering at the UW [191] [192].

3.0 Research Questions and Hypothesis

Q1. Are educational planners and curriculum developers aware of these emerging technologies to help create relevant curricular that will reinforce the production of quality and skilled graduates in our modern civilization? Good and balanced curriculum is a pre-requisite for national development.

Q2. Do these educational planners go for regular training abroad and attended related international conferences to update themselves in balanced curriculum development?

Q3. Do we believe that the present curricular in our higher institutions require a rethink, restructuring and embellishment to enhance the production of skilled manpower?

Q4. Do we believe that the budget for meaningful Research and Development efforts in our tertiary institutions is not adequate and is affecting negatively innovation in science and technology?

Q5. Do you believe that the non-innovative tendency of Nigeria's tertiary institutions is affecting quality journal article production in international journals, and that this has affected the rating of Nigerian universities in World University ranking?

Null Hypothesis

Ho1 Educational planners and curriculum developers are not aware of most emerging technologies that could influence the production of balanced curricular.

Ho2 Innovations in Science and Technology are not negatively affected in Nigeria's tertiary institutions by poor and inadequate budget by the state and Federal Governments.

Ho3 The present curricular in Nigeria's tertiary institutions are not weak, insufficient, unbalanced for the production of industry-relevant and skilled middle, high level manpower, and therefore requires no restructuring, updating and unification for the purpose of enhancement, integration of the present, the future developments in science and technology.

4.0 Questionnaire Administration

The complete questionnaire is found in **Appendix A.** The questionnaire was distributed to a sample population of 2000 professionals as follows:

a. Directors of academic planning: 1000 from selected institutions
b. Lecturers 500
c. Industry 500

Statistical Model adopted: Single Factor Analysis of Variance (ANOVA) to analyze field data for summary of Findings. The general model for a single factor ANOVA is:

The null hypothesis pre-supposes that the means are all equal thus:

$$H_0 : \mu_1 = \mu_2 = \ldots = \mu_k \qquad (1)$$

The alternative hypothesis states that at least one of the means is different

P-Values

The P-value is crucial for accepting or rejecting a hypothesis correctly. It is arrived at by converting test statistic by comparing its value to distribution of test static's under the null hypothesis. The rule for P-value is as stated below:

P-value $\leq \alpha \Rightarrow$ Reject H_0 at level α

P-value $> \alpha \Rightarrow$ Do not reject H_0 at level α

The alpha deployed in the test of our hypothesis is 0.05 which is 95% confidence level. On the basis of the above parameters, the data and results obtained from the ANOVA tests are presented below:

5.0 Data Presentation and Analysis

Table 2: Analysis of Respondents

Groups	No of Q Administered	No. Returned	%Returned
Education Planners	1000	700	70
Lecturers	500	400	80
Industry Professionals	500	350	70
Total	**2000**	**1450**	**73**

Table 3: Responses to Cluster 1

Knowledge Sector	***Emerging Technology***	***TOTAL 'YES'***	***TOTAL "NO***
1. Agriculture science and technology	a. Agricultural Robot	1200	250
	b. Closed ecological Systems	900	550
	c. Precision Agriculture	1300	150
2. Biomedical Technology	a. Artificial uterus	700	750
	b. Body implants, Prosthesis	1150	300
	c. Cryonics	450	1000
3. Display Technology	*a. Holographic Displace, Computer-generated holography*	*1250*	*200*
	b. Phased-array optics	*600*	*850*
	c. Screenless display	*500*	*950*
4. Electronics	*a. Electronic nose*	*700*	*750*
	b. Spintronics	*300*	*1150*
	c. Thermal copper pillar bump	*1000*	*450*
5. Energy	*a. Vortex engine*	*800*	*650*
	b. Artificial photosynthesis	*1000*	*450*
	c. Hydrogen economy	*450*	*1000*
6. IT and Communications	*a. Ambient intelligence*	*250*	*1200*
	b. Artificial brain	*1200*	*250*
	c. Machine translation	*1350*	*100*

7. Manufacturing	*a. Claytronics* *b. Molecular assembler* *c. Utility fog*	*400* *600* *200*	*1050* *850* *1250*
8. Material Science	*a. Aerogel* *b. Conductive Polymers* *c. Femtotechnology, Picotechnology*	*350* *500* *250*	*1100* *850* *1200*
9 Military and Warefare	*a. Caseless ammunition* *b. Electrothermal-chemical technology* *c. Sonic weapon*	*600* *200* *150*	*850* *1250* *1300*
10. Neurosciences	*a. Brain-reading Neuroinformatics* *b. Electroencephalographyc.* *c. Neuroprosthetics*	*400* *350* *650*	*1050* *1100* *800*
11. Robotics	*a. Molecular Nanotechnology - Nanorobots* *b. Powered exoskeleton* *c. Swarm robotics*	*400* *200* *350*	*1050* *1250* *1100*
12. Transport	*a. Alcubierre drive* *b. Driverless car* *c. Flying car*	*450* *800* *450*	*1000* *650* *1000*
Knowledge Sector	***Emerging Technology***	***TOTAL 'YES'***	***TOTAL "NO"***
13. Others	*a. Cloak of invisibility* *b. Technological singularity* *c. Internet of all things* *d. Mobile devices without battery* *e. Domed city* *f. Immersive virtual reality* *g. Synthetic genomics* *h. Asteroid Mining* *i. Arcology* *j. Bioplastic* *k Anti-gravity*	*350* *430* *900* *1250* *600* 1150 300 1200 500 800 ***1100*** **1150**	*1100* *1020* *550* **850** 300 1150 250 950 650 350 250 **300**
	Mean Value (YES)/(NO)		

6.0 Data Presentation, Interpretation of results and findings

Cluster 1 intended to confirm whether or not Educational planners, managers and lecturers are aware of emerging technologies

to brighten the development of balanced curricular with the future in mind. This is presented thus:

$H_0 : \mu_1 = \mu_2 = \ldots = \mu_k$. Table 3 presents the ANOVA results.

Table 3:Result of ANOVA computation

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	48	32130	669.375	131337.9
Column 2	48	37420	779.5833	129646.6

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	291501	1	291501	2.233857	0.138366	3.942303
Within Groups	12266273	94	130492.3			
Total	12557774	95				

At α = 0.05 Fcal = 2.233857, Fcrit = 3.942303 and P-value = 0.138366 and given that p-value is > α, the Null hypothesis which stipulates that Educational planners, lecturers, soldiers and managers are not aware of the emerging technologies is accepted. This also implies that there is a difference in the two means which vindicates the decision. Thus, the problem with our curricular and the problem of poor quality graduates is negatively affecting production of skilled graduates in Nigeria.. So further investigation which is handled in Cluster may provide the light in the tunnel.

Cluster II

Table 4 below summarizes the result of 8 key questions from the respondents

Table 4: Responses from cluster II questions in Appendix A

Qno	YES Response "Yes"	No Response "No"	%YES	%NO
Q1	1450	0	100	0
Q2	100	1350	6.896552	93.10345
Q3	1450	0	100	0
Q4	150	1300	10.34483	89.65517
Q5	1450	0	100	0
Q6	1450	0	100	0
Q7	1350	100	93.10345	6.896552
Q8	1400	50	96.55172	3.448276

Table 5: ANOVA RESULT for Cluster II questions

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	8	8800	1100	363571.4
Column 2	8	2800	350	363571.4
Column 3	8	606.8966	75.86207	1729.234
Column 4	8	193.1034	24.13793	1729.234

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5905702	3	1968567	10.77779	7.01E-05	2.946685
Within Groups	5114209	28	182650.3			
Total	11019911	31				

Hypotheses 2 and 3 and related research questions have been answered by ANOVA computation in Table 5. At $\alpha = 0.05$, Fcal = 10.8, Fcrit = 2.95 and p-value greater than α, the Null hypothesis 2 and 3 are accordingly accepted in favour of the alternative hypotheses. This implies that Innovations in Science and Technology is negatively affected in Nigeria's tertiary institutions due to poor, inadequate budget by the state, Federal Governments and that the present curricular in Nigeria's tertiary institutions are weak, insufficient, unbalanced for the production of industry-relevant and skilled middle, high level manpower, and therefore requires restructuring, updating and unification for the purpose of enhancement, integration of the present, the future developments in science and technology.

Below are samples of free comments made by respondents which support our proof of hypothesis 1-3 and research questions 1-8:

This is free-form response is from a Professor of Industrial Chemistry from one of Nigeria's solid ivory towers.

- *Extremely poor funding of the education sector at all levels is the bane of R&D in Nigeria.*
- *The Nigerian professors are still as good as their counterparts in any other part of the world.*
- *The problem is that motivation for Intellectuals in Nigeria are at the lowest ebb.*
- *A situation in which people of far less intellectual endowment than the university professors are remunerated with unimaginably jumbo emoluments while the professors take peanuts as salaries is, to say the least, insulting and gravely discouraging. Intelligence should not continue to be a curse in Nigeria.*
- *In view of the above, professors are now forced to accept government appointments at the risk of sacrificing their traditional academic roles and to the detriment of R&D in Nigeria.*
- *A situation where there is no single foreign*

lecturer in any public university in Nigeria speaks volumes on the conditions of service of Nigerian lecturers.

- *Again, students are no longer properly and adequately fed in good cafeteria environment. Since 1978 when the subsidized feeding of Nigerian students in cafeteria was stopped by government, the students have been eating in ramshackle bukas. This poor and improper feeding under highly unhygienic conditions has made the Nigerian undergraduates not to know their worth anymore. That is why one can now see some undergraduates get involved in various criminal activities and even serve as thugs for people.*
- *Students now live in uncompleted houses outside campuses and overpopulated rooms on campuses making reading and research very difficult to the detriment of R&D.*
- *The lack of jobs after graduation is another great discouragement to hard work and studies by students.*

I, therefore, suggest as follows: 1. Restore the worth and dignity of students by restoring subsidized decent cafeteria feeding and conducive living and study environment in institutions of learning in Nigeria. 2. Restore the integrity and pride of the intellectuals in Nigerian universities and other institutions of learning through adequate remuneration and provision of enhanced work infrastructure such as private professorial and general laboratories and other conducive work and social campus conditions. 3. Fund education in general adequately and provide jobs for the youths. Afterall, Education is the Bedrock of Development in any Community, Society, or Nation.

Another free comment from the banking industry*:*

- *Corruption is at the root of the systemic decay that has engulfed the Nigeria state and has successfully eroded any ethical foundation and value system that hitherto existed.*
- *This corruption manifests in every sector of our economy with a brazen demonstration by our politicians and public servants.*
- *This corruption has ensured that funds that should have been channeled to sensitive areas of the economy, for example, education, are misappropriated and outrightly embezzled.*
- *This corruption has also manifested actively in our tertiary institution [educational sector] and has ensured that the little funds that find its way to this sector is also misappropriated by people and structures who believe that they must compete, if not outwit, their politician counterparts in the corruption that has become institutionalized. Only a fraction of our academia can actually be exempted from this craze for inordinate wealth and ambition*

Several other free comments reflect the opinion of the above two commentaries.

7.0 Summary, conclusions and Recommendations

From the statistical analysis and commentaries from respondents, there is evidence that**:**

i. The present curricular need be recast, embellished and unified for the upliftment of the quality of graduates in Nigeria's tertiary institutions
ii. The poor curricular and ill-equipped laboratories have lead to the production of pseudo-illiterates as graduates, who the industry claims, are not employable.
iii. That tertiary institutions should be properly funded by government as a Critical National Resource (CNR).
iv. The negative side of poor remuneration to university lecturers is partly responsible for the non-motivation for R&D, hence evidence of poor research productivity and its concomitant absence of innovation.

vi. The elimination of cafeteria service has grossly affected the performance of students due to poor nourishment. Also the scrapping of hostels in most public institutions has lead to poor culture of academic indiscipline and un-seriousness by students and need be remedied.

vii. Corruption in public institutions has contributed in no small measure to the rot also in the educational sector. Part of this corruption is honouring rogues and politicians of poor reputation and character in place of citizens who are making meaningful contributions to the development of Nigeria. Also lecturers who are the products of examination malpractice are now component part of the new face of education in Nigeria. It is this set of lecturers that are involved in sorting and all sorts of examination malpractices which is currently the bane of our educational institutions.

We therefore conclude that all is not well with Nigeria and her educational system in its entirety and that something drastic (state of emergency) must be done urgently to avert its total collapse.

We, therefore, recommend that**:**

i. The National Universities Commission, National Board for Technical Education, National Commission for Colleges of Education along with professional bodies should, as a matter of urgency, organize a National Education Emergency symposium to address the myriads of rots in the system and rethink, restructure, embellish and unify the existing tertiary curricular to embrace the future, spirit of pragmatic research and innovation as academic culture.

ii. There is need to look at the remuneration structure of other national tertiary institutions for the purposes of ending the de-motivation of teachers in teaching and research. A situation where a Counselor is earning more than a professor is nauseating and discouraging**.** *The dignity of the teacher must be restored.*

iii. Educational planners and teachers must be retrained regularly on the emerging technology trends to improve their skills in curriculum architecturing via workshops and conferences in Nigeria and abroad.*This will mean providing adequate budget allocation by the federal and state governments.*

iv. Government should rethink the award of national honours by respecting the sacrifice of teachers and researchers as opposed to the present practice of honouring mostly politicians who may not have made meaningful sacrifice for the development of Nigeria.

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Appendices

A. Sample Questionnaire

Appendix A: Questionnaire design and administration

Dear Colleagues,

The industry and the academia are complaining bitterly on the low quality of graduates we are churning out of our tertiary institutions and that they are not employable. Moreover, the academia is not innovative and productive in R&D. Worried about these complaints; a collaborative research is being conducted to find out what the problems are. Is it poor curricular planning? Is it corruption or weak morality in academia? Has lack of dedication by lecturer s any relationship with apparent lack of innovation as obtains in other institutions around the world? What are current world innovations in science and technology and to what extent are our educational planners and the academia aware of these technologies so that they can integrate the future into our new curricular? Please support this collaborative research by completing the questionnaire below promptly and send to: Profoliverosuagwu@gmail.com. It is hoped to be published in an AJOL-indexed international journal this September. The outcome of this research will enable Nigeria to reconstruct tertiary education curricula, possibly unify them and initiate a new national psyche that embrace a culture of innovation and creativity in our tertiary institutions. We would like to end this appeal with the words of John Done "any man's death diminishes me because I am involved in mankind. You never know to whom the bell tolls, it tolls for thee". *We shall therefore be grateful for your support for the good of Nigeria.*

Sincerely

Prof O E Osuagwu
Research Team Leader

Questionnaire Response

This is a three-page Questionnaire. *It is a* YES *(1) or* NO(0) *answer to simplify the process and a Single factor ANOVA will be deployed in the analysis of data collected to test the five hypotheses and research questions posed. Cluster 1 assesses the level of awareness of educational planners, managers to a broad category of 11 knowledge spectra. They include: Agricultural science and technology, Biomedical Technology, Display Technology, Electronics, Energy, IT and communications, Military Technologies, Neurosciences, Robotics, Transport Technology and other emerging technologies. Three emerging technologies were taken as sample for each knowledge area except for* **others** *which attracted 10 new emerging technologies.*

Cluster II *requires some information to be provided to some questions for formal analysis of some issues raised. It is also a YES OR NO answers. A section of cluster II requests the respondent's input to the current national malaise and to propose strategies to solve them.*

Name:……
Affiliation:……
Contact Tel.……email address.……..
Highest academic and professional attainment:……..
Present status:……..

Table 1: choice of Emerging Technologies used in the Test

Knowledge Sector	***Emerging Technology***	***Choice (Y/N) Y = have some Faint knowledge of the Technology = 1. N = no idea - 0***
1. A griculture science and technology	a. Agricultural Robot b. Closed ecological Systems c. Precision Agriculture	[Y/N] [Y/N] [Y/N]
2. Biomedical Technology	a. Artificial uterus b. Body implants, Prosthesis c. Cryonics	[Y/N] [Y/N] [Y/N]
3. Display Technology	a. Holographic Displace, Computer- generated holography b. Phased-array optics c. Screenless display	[Y/N] [Y/N] [Y/N]
4. Electronics	a. Electronic nose b. Spintronics c. Thermal copper pillar bump	[Y/N] [Y/N] [Y/N]
5. Energy	a. Vortex engine b. Artificial photosynthesis c. Hydrogen economy	[Y/N] [Y/N] [Y/N]
6. IT and Communications	a. Ambient intelligence	[Y/N]

	b. Artificial brain c. Machine translation	[Y/N] [Y/N]
7. Manufacturing	a. Claytronics b. Molecular assembler c. Utility fog	[Y/N] [Y/N] [Y/N]
8. Material Science	a.	
9 Military and Warefare	a. Caseless ammunition b. Electrothermal-chemical technology c. Sonic weapon	[Y/N] [Y/N] [Y/N]
10. Neurosciences	a. Brain-reading Neuroinformatics b. Electroencephalography c. Neuroprosthetics	[Y/N] [Y/N] [Y/N]
11. Robotics	a. Molecular Nanotechnology - Nanorobots b. Powered exoskeleton c. Swarm robotics	[Y/N] [Y/N] [Y/N]
12. Transport	a. Alcubierre drive b. Driverless car c. Flying car	[Y/N] [Y/N] [Y/N]
13. Others	a. Cloak of invisibility b. Technological singularity c. Internet of all things d. Mobile devices without battery e. Domed city f. Immersive virtual reality i. Synthetic genomics j. Asteroid Mining k. Arcology l. Bioplastic m Anti-gravity	[Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N] [Y/N]

Cluster II: Please answer YES or NO to the following questions

1. *Are you aware that the Industry and the academia are complaining of an emerging trend which says that Nigeria graduates are unemployable, have no skills and have shallow knowledge of areas of specialization? [Y/N]*
2. Do you believe that our educational planners and curriculum developers are not aware of emerging technologies to help create relevant curricular (with the future in focus) that will reinforce the production of quality and skilled graduates in our modern civilization?

3. Do you believe that good and balanced curriculum is a pre-requisite for national innovation and technological development? [Y/N]
4. Do you believe that a large proportion of managers and educational planners are not given the opportunity to undergo conferences abroad to retool themselves for the challenges of the 21st emerging technologies? [Y/N].
5. Do you believe that the present curricular in our higher institutions require a rethink, restructuring, embellishment and unification to enhance the production of skilled manpower? [Y/N].
6. Do you believe that the budget for meaningful Research and Development efforts in our tertiary institutions is not adequate and is affecting negatively innovation in science and technology? That is to say Nigeria is paying lip service to the issue of R&D and innovation. [Y/N].
7. Do you believe that the non-innovative tendency of Nigeria's tertiary institutions is affecting quality journal article production in international journals, and that this has also affected the classification of Nigerian universities in World University rating? [Y/N].

8. The present curricular in Nigeria's tertiary institutions are weak, insufficient, unbalanced for the production of industry-relevant and skilled middle, high level manpower, and therefore requires restructuring, updating and unification for the purpose of enhancement, integration of the present, the future developments in science and technology. [Y/N]

9. Please make your free remarks on the problems confronting Nigeria on the issues of production of low quality graduates, the tertiary curriculum, low R&D budgets and absence of innovation in science and technologies that address questions 1-8. Propose solution strategies to this national malaise. Bullet your points and solutions suggested.