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CONTENTS

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RESEARCH ARTICLE

Numerical study of convective heat transfer and of turbulent forced of different Nanofluids in channel

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Abstract
In this study, the flow field and heat transfer of different nanofluids (AL2O3, CuO, SiO2, ZnO), turbulent forced convection in a channel. The surface of the channel is hot Th= 310 K. Simulations are carried out for constant water Prandtl number of 6.99, Reynolds numbers from 20,000, 30,000, 40,000, 50,000 to 60,000, nanoparticles volume fractions of 0, 0.01, 0.02, 0.03, 0.04 and nanoparticles diameter of 30 nm. The finite volume method and SIMPLE algorithm and k-e are utilized to solve the governing equations numerically. The numerical results showed that with enhancing Reynolds numbers and volume fractions, average Nusselt number increases.

Keywords: Nanofluid; channel; Turbulent flow; Forced convection; Nusselt number; Numerical solution; Reynolds numbers

Introduction

Turbulent flow in the channels is the subject of importance in many engineering applications and of interest to many researchers. Some of them include energy conversion systems found in the same nuclear reactor design, heat exchangers, solar collectors, and cooling of industrial machinery and electronic components. Of great importance for the innovation of these studies in addition to experimental and numerical techniques is the research on the flow and heat transfer processes for the improvement of heat exchangers. Large-scale experimental studies of turbulent flow, heat transfer and heat exchangers have been carried out by various authors. The digital study by DIAO XU et al [1] is based on the Computational Fluid Dynamic method for improving the performance of nanofluid flows and heat transfer in micro channels. It has been found that nanoparticles improve the heat transfer of fluids by a certain percentage, and cause a sharp increase in viscous shear stress on the wall, which leads to an increase in the power to pass nanofluids into the wall. the canal. Adnan M Hussein et al [2] with the aim of improving convective turbulent heat transfer and studied numerically the flow of the heated tube using TiO2-water nanofluid, was used to predict the friction factor and the Nusselt number for heat transfer by forced convection of the TiO2-water nanofluid. The Reynolds number range is 10,000 to 100,000 to be turbulent flow in a horizontal straight tube with a heat flow of 5,000 w / m2. Azher M et al [3] studied numerically from a turbulent flow fully developed heat transfer behavior in trapezoidal channel systems, when using several types of nanoparticles (Al2O3, CuO, SiO2, ZnO), with different volume fractions (0% to 4%), and diameter (20nm-80nm) and a heat constant of 6kw / m2; the results indicate that SiO2 has the highest Nusselt number compared to the others. To improve heat transfer, it is a matter of increasing the volume concentration of nanoparticles and reducing the diameter if the pressure drops increase. Ajay Singh et al [4] studied numerically was carried out to observe the effect of the nanofluid on the characteristics of heat transfer by convection in the developing region of the flow of the tube, the average particle size varies from dp = 15 at 150 nm and a particle concentration of 1, 2, 4, 6 and 10% were used in this work. The single-phase method with constant heat flow to the wall was used for the analysis. Jubair A. Shamim et al [5] numerically evaluated computational fluid dynamics (CFD) is performed to determine the thermo- and hydrodynamic performance of the water-alumina (Al2O3) nanofluid in a square subchannel exhibiting ratios pitch-diameter of 1.25 and 1.35 Two fundamental aspects of thermal hydraulics. Heat transfer and pressure drop are evaluated under typical pressurized water reactor (PWR) conditions at different flow rates (300,000 <Re <600,000) using pure water and different concentrations of water-alumina nanofluid (0.5–3.0 vol. %) as coolant. The experimental study led by M. Siva Eswara Rao et al [6] using nanoparticles with a diameter of 28 nm (Al2O3) with different volume concentrations (0.1%, 0.2%, 0.3%, 0.4%) in a tube with several exchanger passes heat transfer coefficient to improve the heat transfer coefficient by forced convection under turbulent flow conditions, the inlet and outlet temperature are measured and the nanofluid volume fraction concentration is tested with the same temperature and speed. If we add the nanoparticles

in the base fluid, we improve the heat transfer and we increase the conductivity, density, thermal diffusivity and friction factor. AV Minakov et al [7] have experimented with the forced (turbulent) convection of nanofluids in cylindrical and spherical cavity channels, with nanoparticles of zirconium oxide (ZrO2) of average size of 44 and 105, the Reynolds number varying from 3000-8000. Note that the increase in heat transfer coefficient and pressure drop, that the use of nanofluids depends on the shape of the channel surface. The object of the study by Sami D. Salman et al [8] was improved heat transfer rate compared to individual uses of ribs or nanofluids. The main objective of the present research is to study the combined effects of various programs of the types of nanofluids ZnO, CuO, Al2O3 and SiO2 with various volume fractions (1% -4%) and different sizes of nanoparticles (dp = 30 nm, 40 nm, 50 nm and 60 nm) in a constant thermal flux tube with rectangular, triangular and trapezoidal ribbed by ANSYS-FLUENT version 16 software using the standard model k-ε. So using nanofluids with different ribbed tube configurations is the most effective technique. For the other application improves heat transfer rate compared to individual use of ribs or nanofluids. Hamdi E et al [9] launches a digital study of the turbulent flow of nanofluids in a triangular rib duct, nanoparticles (Al2O3, SiO2) with EG base fluid (Ethylene Glycol) are used, the volume concentration varies from 1% up to 'at 6%, the Reynolds number is 4000-32000. The results in the case of SiO2-EG are 6% of the volume, Re = 32000, the Nusselt number is higher compared to the number of Re = 4000. So if we increase the concentration of nanoparticles, we notice an increase in the coefficient of friction. Mohammad Hemmat Esfe et al [10] This article reviews and summarizes the application of fluids and nanofluids in photovoltaic thermal systems (PVT). Numerical, analytical and experimental literatures are studied. PVT introduced as a combined version of solar collectors and photovoltaic technology to achieve simultaneous generation of thermal and electric energy is a combination of photovoltaic and solar collector technology in a system that simultaneously generates electric and thermal energy. The application of fluids and nanofluids in PVTs was evaluated by a study of single fluid flows, dual fluid (air-liquid) flows, phase change materials (PCM) and nanofluid flows. The aim of this work is Numerical study of the turbulent flow field of different nanofluids (AL2O3, CuO, SiO2, ZnO), through a tube, the heat flow constant and uniform at the walls. The analysis of the turbulent nanofluid flow in this tube allows understanding the thermal behaviour in different nanoparticle concentrations. The improvement of the heat transfer increases with the volume concentration of the particles and the Reynolds number and the comparisons with the correlations. The results of the simulation are then analysed to explain the thermal phenomena occurring in the system.

The schematic of geometry studied:

A numerical simulation of heat transfer by forced convection in a channel is considered in 2 dimensions where the geometry is shown in figure 1. The configuration of the simulation via fluent 6.3.26 involves a channel with a length of 0.5 m and with a diameter of 0.02 m whiles the wall channel exhibiting a constant temperature of 310 K. The initial condition and at the limits of the simulation, the temperature of the nanofluids will be set at an initial value of 300 K at the inlet. The parameters studied varied with each simulation adopting a Reynolds number of 20,000 and 60,000 and at a variable volume fraction of 1 - 4%. In this study, the simulated nanofluids are assumed to be incompressible, single-phase, exhibiting a stable and turbulent flow with constant thermophysical properties.

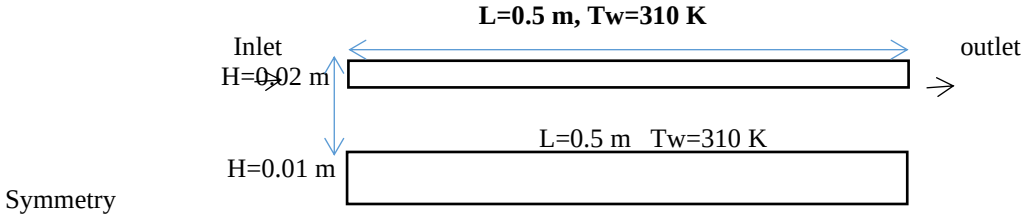

Fig. 1. Geometry of the channel model.

The governing equations

Continuity equation:

$$\frac{\partial}{\partial x_i}(\rho u_i) = 0$$

Momentum equation:

$$\frac{\partial}{\partial x_i}(\rho u_i u_j) = -\frac{\partial p}{\partial x_i} + \frac{\partial}{\partial x_j}\left[\mu\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right)\right] + \frac{\partial}{\partial x_j}(-\overline{\rho u'_i u'_j})$$

Energy equation:

$$\frac{\partial}{\partial x_i}(\rho u_i T) = \frac{\partial}{\partial x_j}[(\Gamma + \Gamma_t)\frac{\partial T}{\partial x_j}]$$

Where and are the molecular viscosity and the vortex viscosity, respectively.

Turbulence Model

The turbulence model selected in the simulations is the standard k-ε turbulence model with its associated enhanced near-wall function enabled with the software running simulation.

The standard k-ε turbulence model in two ways of formulation regarding turbulent viscosity and dissipation rate ε transport equation.

Turbulent kinetic energy equation k-ε:

$$\frac{\partial}{\partial x_j}(\rho k u_j) + \frac{\partial}{\partial t}(\rho k) = \frac{\partial k}{\partial x_j}\left(\mu + \frac{\mu_t}{\sigma_k}\right) + G_k + S_k - \rho\varepsilon$$

Where Gk is the generation of kinetic turbulence energy due to average velocity gradients and it is expressed as

$$G_k = (-\rho\overline{u_i u_j})\frac{\partial u_j}{\partial x_i}$$

And based on the Boussines hypothesis, Gk is defined as

$$G_k = \mu_t s^2$$

The rate of dissipation of turbulent kinetic energy ε is defined as follows:

$$\frac{\partial}{\partial t}(\rho\varepsilon) + \frac{\partial}{\partial x_j}(\rho\varepsilon u_j) = \frac{\partial \varepsilon}{\partial x_j}\left(\frac{\partial}{\partial x_j}(\mu + \frac{\mu_t}{\sigma_\varepsilon})\right) + \rho(C_1 s\varepsilon - C_2\frac{\varepsilon^2}{k + \sqrt{v\varepsilon}} + s\varepsilon$$

The values of the constants in the above equations:

C1 = 1.44, C2 = 1.9, σ_ε = 1.2

$C_1 = \max(0.43, \frac{\eta}{\eta+5})$

$$\eta = s\frac{k}{\varepsilon}$$

$$s = \sqrt{2(s_{ij})^2}$$

$$\mu_t = \rho C_\mu \frac{k^2}{\varepsilon}$$

$$C_\mu = \frac{1}{A_0 + A_s\frac{ku^*}{\varepsilon}}$$

Numerical procedure

The governing equations with the connected boundary conditions are numerically solved using the finite volume method. The thermophysical properties like thermal conductivity and viscosity, which are variable with temperature, are solved concurrently with flow, temperature in the whole solution domain. On the control volume faces these properties are averaged the calculated values on the grids. The SIMPLE algorithm has been adopted to solve for the pressure and the velocity components. The coupled sets of discretized equations have been solved iteratively using a line-by-line procedure.

Table 1: Thermophysical properties of the base fluid and the nanoparticles used in this study [11, 12, 13 and 14]:

property	Pure water	AL2O3	CuO	SiO2	ZnO
Density ρ (kg/m3)	998	3970	6500	2200	5600
Specific heat Cp (j/kg.k)	4182	765	535.6	703	495.2
Thermal conductivi K (w/m.k)	0.597	40	20	1.2	13
Dynamic viscosity μ (Ns/m2)	0.000998	-	-	-	-

Mesh independent test

In the present study, I chose the size of the grid near the boundary layer flow channel wall near the wall at Reynolds number Re = 40,000. I do the network independence tests that were performed to assess the

effects of grid sizes on maximum temperature, outlet velocity and maximum fluid along the channel. Four mesh sets were generated with the node numbers 200x40, 212x42, 218x43, 220x43; 225x45 and 250x50, respectively. It has been noticed that the Nusselt number of 218x43 nodes gives closer and acceptable results to validate the results, was selected to save computation time. The different grids, Re = 40,000.

Mesh	T max	V outlet	V max
200x40	309,8311	1,1074	2,2706
212x42	309,8943	1,0678	2,2631
218x43	309,9164	1,0483	2,2594
220x43	309,9164	1,0483	2,2594
225x45	309,9476	1,0101	2,2521
250x50	309,9835	0,9198	2,2345

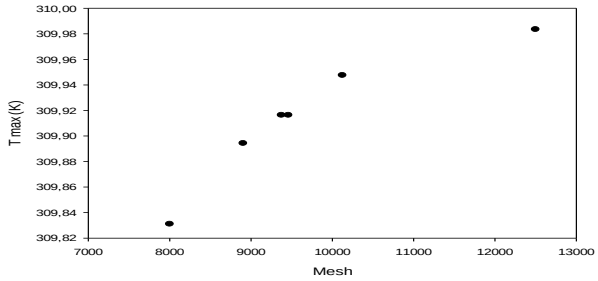

Fig. 2. Grid independence test Maximum temperature

Validation

The simulations were carried out using the FLUENT 6.3.26 software. A finite volume process was used to numerically solve the continuity, momentum and energy equations using the turbulence model. The standard k-ε model with SIMPLE algorithm was selected for the simulation. The convergence criterion is considered to be 10−6 for all the variables.

In order to validate the numerical procedure, the relations presented with Gnielinski [15], Pak and Cho [16], Maiga al. [17] and Dittus boelter correlation [18]. The results are compared with the existing results in the literature.

Gnielinski [15]:

$Nu = 0.012\ (Re^{0.87} - 280)\ Pr^{0.4}$ $1.5 \leq Pr \leq 500$, $3*10^3 \leq Pr \leq 10^6$ (19)

Pak & Cho [16]:

$Nu = 0.021\ Re^{0.8}\ Pr^{0.5}$ (20)

Maiga & al. [17]:

$Nu = 0.085\ Re^{0.71} Pr^{0.35}$ (21)

Dittus boelter correlation [18]

$$Nu = 0.023 Re^{0.8} Pr^{0.4}$$

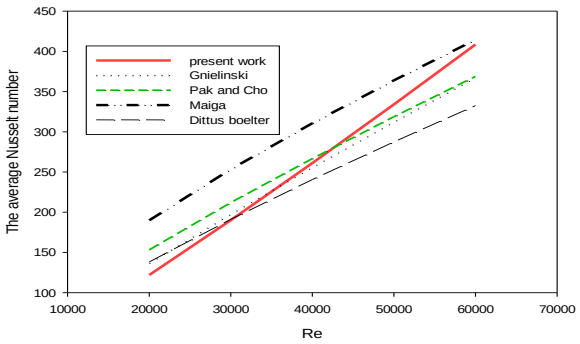

Fig.3. Comparison of the present results with equations of Gnielinski [15], Pak and Cho [16], Maiga al. [17] and Dittus boelter correlation [18].

The equations considers for evaluates nanofluids

The following formulas are used to determine properties such as density, specific heat, dynamic viscosity, and thermal conductivity (Eq; 1, 2, 3.4) of the nanofluid.

Density:

The density of the nanofluid is given as [19]:

$$\boldsymbol{\rho_{nf} = (1-\varphi)\rho_{bf} + \varphi\rho_p} \quad \textbf{(1)}$$

Where ρf and ρnp are the density of the based fluid and the solid nanoparticles, respectively.

Heat capacity:

The heat capacity of the nanofluid is expressed as [20]:

$$\boldsymbol{Cp_{nf} = (1-\varphi)Cp_{bf} + \varphi Cp_p} \quad \textbf{(2)}$$

Where (ρCp) and (ρCp) are the heat capacity of the based fluid and the solid nanoparticles, respectively.

Dynamic viscosity:

The effective dynamic viscosity of the nanofluid is given as [21]:

$$\boldsymbol{\mu_{nf} = \mu_{bf} * \frac{1}{(1-34.87*(d_p/d_f)^{-0.3}*\varphi^{1.03})}} \quad \textbf{(3)}$$

$$\boldsymbol{d_f = \left[\frac{6*M}{N*\pi*\rho_{bf}}\right]}$$

Where M is the molecular weight of the base fluid, N is the Avogadro number = 6.022 × 1023 moL−1, and ρfo is the

mass density of the base fluid calculated at temperature T_0 =300K. It could be noticed that, for simplicity in this study, the changes of viscosity with temperature along the channel and the viscosity at all points is considered to be the same as the viscosity at inlet temperature

Thermal conductivity

The effective thermal conductivity of the nanofluid is given as [22]:
By considering Brownian motion of nanoparticles in channel, the effective thermal conductivity can be obtained by using the mean empirical equations:

$$\mathbf{K_{eff} = k_{static} + k_{brownian}} \quad \textbf{(4)}$$

Where k_{static} indicates the thermal conductivity improvement from the advanced thermal conductivity of nanoparticles and k_{Brownian} represents the effect of Brownian motion of particles. k_{Brownian} has also considered the influence of movement of fluid particles with nanoparticles. Consider the following:

$$\boldsymbol{k_{static} = k_{bf}\left[\frac{(k_p + 2k_{bf}) - 2\varphi(k_{bf} - k_p)}{(k_p + 2k_{bf}) + \varphi(k_{bf} + k_p)}\right]}$$

Where ks and kf are thermal conductivities of the nanoparticles and the base fluid, respectively. Consider the following:

$$\boldsymbol{k_{brownian} = 5 * 10^4 \beta\varphi\rho_{bf} Cp_{bf}\sqrt{\frac{K_B T}{2\rho_p d_p}} f(T,\varphi)}$$

where ρ_f and ρs are the densities of the base fluid and the particles, respectively, and $Cp,_f$ is the specific heat capacity of the base fluid. K_B is the Boltzmann constant, 1.381 × 10−23 J/k. β is a parameter which indicates the effect of interaction between nanoparticles and the movement of fluid around the particles. f (T, 0) represents the temperature dependency of nanofluids, where both (T,) and β were obtained by utilizing the existing experimental data. The modified (T,) equation was reported by Vajjha and Das [22]:

$$f(T,\varphi) = (2.8217 * 10^{-2}\varphi + 3.917 * 10^{-3})\left(\frac{T}{273.15}\right) + (-3.0669 * 10^{-2}\varphi - 3.91123 * 10^{-3})$$

The values of β for different nanoparticule types [23, 24]:

Type particule	β	Concentrati (%)	Températu (K)
Al2O3	$8.4407(100\varphi)^{-1.}$	$1\% \le \varphi \le 1$	298K ≤ T 363K
CuO	$9.881(100\varphi)^{-0.9}$	$1\% \le \varphi \le 6$	298K ≤ T 363K
SiO2	$1.9526(100\varphi)^{-1.}$	$1\% \le \varphi \le 1$	298K ≤ T 363K
ZnO	$8.4407(100\varphi)^{-1.}$	$1\% \le \varphi \le 7$	298K ≤ T 363K

Calcul of β for different nanoparticule types

	β 1%	β 2%	β 3%	β 4%
AL2O3	0,713409	4,012003	2,596619	1,906971
CuO	9,881	5,133907	3,500356	2,667442
SiO2	1,9526	0,710052	0,392919	0,258206
ZnO2	8,4407	4,012003	2,596619	1,906971

Results and discussion

To study the effect of the volume fraction of different nanoparticles (AL2O3, CuO, SiO2, ZnO), on the mean Nusselt number. Here, the effect of the volume fraction of nanoparticles on the mean Nusselt number is presented for dp = 30 nm. Figures (4, 5, 6, 7) shows the variations of the mean Nusselt number as a function of the Reynolds number for different volume fractions. For all the volume fractions studied, the mean Nusselt number increases with the increase in the Reynolds number. This is acceptable due to the increase in the conductivity of the nanofluid and the subsequent improvement in heat transfer. The other reason for this increase in the mean Nusselt number is the acceleration of energy transport due to the random motion of nanoparticles (Brownian motion) inside the nanofluid. This process allows a more uniform temperature distribution inside the nanofluid and therefore an improved heat transfer rate between the nanofluid and the wall.

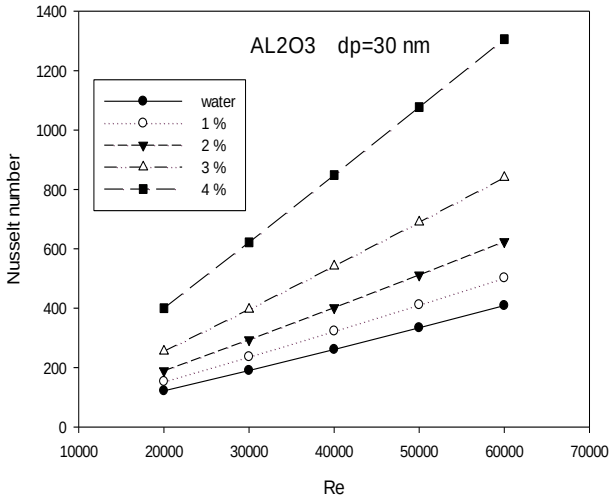

Fig.4. The effect of different concentrations of volume nanoparticles AL2O3 at different Reynolds numbers on the Nusselt number

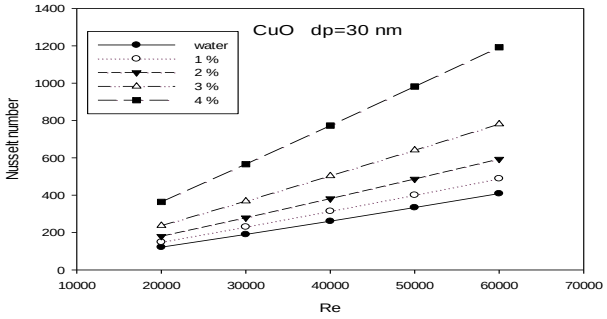

Fig.5. The effect of different concentrations of volume nanoparticles CuO at different Reynolds numbers on the Nusselt number

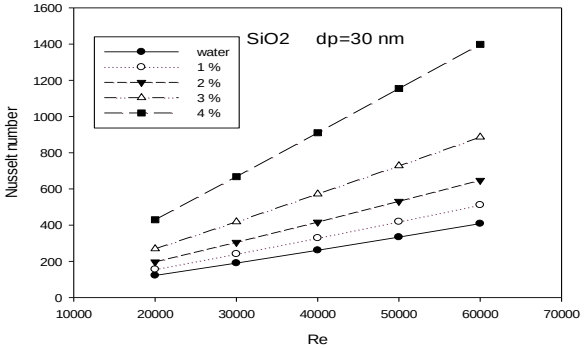

Fig.6. The effect of different concentrations of volume nanoparticles SiO2 at different Reynolds numbers on the Nusselt number

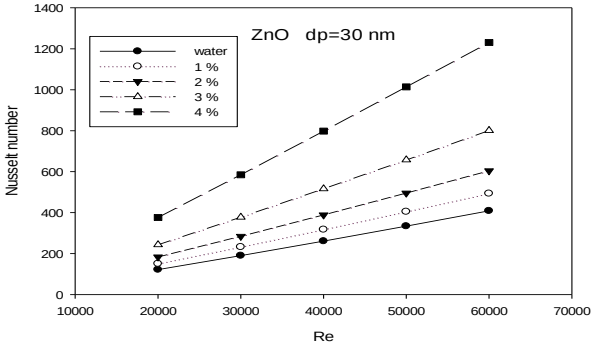

Fig.7. The effect of different concentrations of volume nanoparticles ZnO at different Reynolds numbers on the Nusselt number

The most increment in the average Nusselt number for a fixed volume fraction of 0.01 in figure 8, where the average Nusselt number rises up and for an increment in Reynolds number from 20,000 to 60,000.

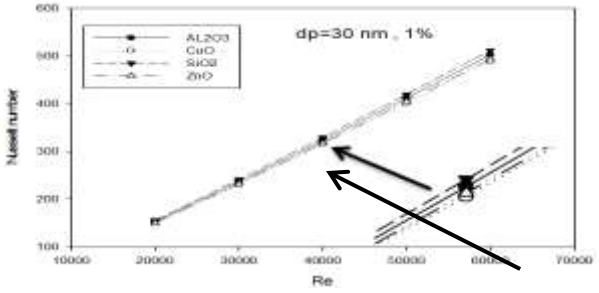

Fig.8. The effect 1 % of different nanofluid at different Reynolds numbers on the Nusselt number.

The most increment in the average Nusselt number for a fixed volume fraction takes place in volume fraction of 0.04 in figure 9, where the average Nusselt number rises up and for an increment in Reynolds number from 20,000 to 60,000.

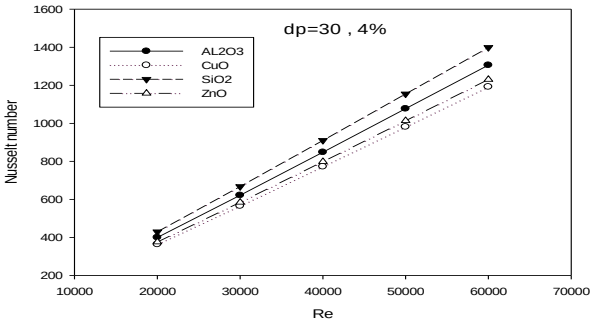

Fig.9. The effect 4 % of different nanofluid at different Reynolds numbers on the Nusselt number.

With an increasing volume fraction ranging from 0.01 to 0.04 for a fixed Reynolds number Re = 40,000, the average Nusselt number increases for nanoparticles figure 10. The mean values of the Nusselt number for the SiO2 nanoparticle differ from other nanoparticles.

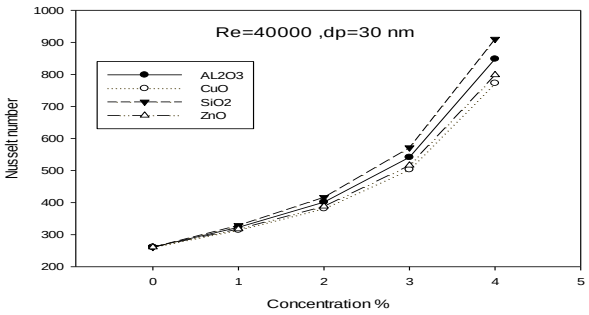

Fig.10. The effect the Reynold number Re=40000 on of different nanofluid at different concentrations of volume nanoparticles on the Nusselt number.

Conclusions

In this study, the forced convection heat transfer of different nanofluids inside a symmetrical channel for Reynolds numbers from 20,000 to 60,000, volume fractions of nanoparticles in a range of 0.01 to 0, 04 and a diameter of 30 nm was considered. The channel wall is maintained at 310 K and the input nanofluid flux is at 300 K. Based on the numerical results.

For all the studied volume fractions, the average Nusselt number increases with increasing Reynolds number.

with increasing the reynolds numbre 20.000 to 60.000 and changed the volume friction up the 0.01 to 0.04 the average Nusselt number the pure water and nanofluid increases.The most increment in the average Nusselt number for a fixed volume fraction takes place in volume fraction of 0.04, where the average Nusselt number rises up to for an increment in Reynolds number from20,000 to 60,000.

Nomenclature

Symbols:

P pressure, Pa
T Temperature, K
H channel height, m
Γ thermal diffusivity, $m^2.s^{-1}$
Γ_t turbulent diffusivity, (…)
k turbulent kinetic energy, $m^2.s^{-2}$
q heat flux, kw.m-2
h heat transfer coefficient, $w.m^{-2}.K^{-1}$
fr friction factor, (...)
L length, m
u speed, $m.s^{-1}$
Re Reynolds number, (...)
Pr Prandt number, (...)
Nu Nusselt number, (...)
U input speed, $m.s^{-1}$

Greek letters:

ρ density, $kg.m^{-3}$
λ thermal conductivity, $W.m^{-2}.K^{-1}$
μ dynamic viscosity, $kg.m^{-1}.s^{-1}$
Cp specific heat kj
αk effective dissipation Prandt number,
μeff effective dynamic viscosity,
ε dissipation kinetic energy, $m^2.s^{-3}$
φ Particle concentration
C1 Constant used in the standard k–ε model
C2 Constant used in the standard k–ε model
Cμ Constant used in the standard k −ε

Index :

W wall,
t turbulent,
eff effective
nf nano fluid
np nano particle
p particle
f base fluid

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RESEARCH ARTICLE

Transiting from Manual Voting to Electronic Voting System for Enduring Democratic Governance in Nigeria: The Imperative for Digital Solutions

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Abstract
The paper investigates the enormity of hitches tied to transiting from manual-based electoral systems to the electronic voting system and determines whether hurdles with the electronic voting system could be sufficient enough to prevent Nigeria from adopting it to enhance her democratic governance in the 21st century. This enquiry was prompted on the ground that there are mixed reactions from different individuals, scholars and societies that the Nigerian state is not ripe for electronic voting and as such may not be able to sustain it if it eventually steps into full adoption of electronic voting system. Therefore, they argue that the status quo ante should be maintained. However, available documentary evidence and cases drawn from other climes where electronic voting has been practised across the globe show that the cost-saving potential of electronic voting is limitless, it eliminates electoral frauds, votes are completed and submitted online, thereby saving ample time, it restricts movement, which eventually eliminates voter apathy caused by fear of violence, etc. On the other hand, most scholars are overwhelmingly inclined to the opinion that the electronic voting system is capable of exacerbating the digital divide as it is lopsided in affecting the turnout of certain groups of citizens. This implies that e-voting will favour only well-educated and wealthy people to the detriment of the downtrodden in the society. The paper however concludes that the Achilles' heels of transiting from manual to the electronic voting system identified are tangential and could be surmounted with the passage of time through sensitization and awareness creation.
Keywords: Manual Voting; Electronic Voting; Democracy; Governance

Introduction

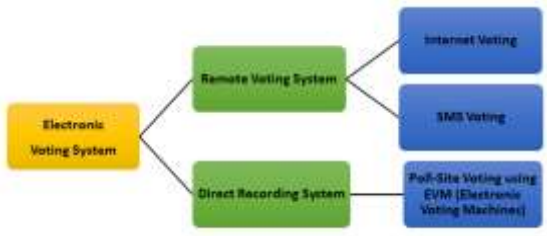
One of the basic functions of elections and the consequences that come with them is the democratic legitimization of those in power (Raciborski, 2003). Election constitutes an important element in liberal democracy (Adejumobi,2000). Elections are tools for ensuring orderly succession and leadership change, as well as a source of political authority and legitimacy. However, Nigeria has always struggled to establish a true democracy through elections (Ajayi, and Ojo, 2014, Babalakin, 2021). This is partly due to the frivolous electoral system in Nigeria characterized with assassination, political bullying, rigging, stuffing and snatching of ballot boxes during and after the election. (Ighodalo, n:d). Substantiating the preceding exposition, Ogunboded and Adelakun, (2018) assert that Nigerian elections are marred with crises, which have hampered democracy and development. Reiterating the ugly scenario as it occurred during the electoral process in Nigeria, the Guardian (2021) reports that votes buying and/or "hands shake" with the people working at the polling stations coupled with physical injuries and fatalities dominated the six national elections conducted between 1999 and 2019 because the system was entirely manual (Stephanie, Burchard & Simati, 2019). The plethora of negative cases arising from the Nigerian elections necessitates the implementation of a total electronic voting system as the only solution for a credible, free, and fair election in Nigeria. Corroborating this view, Nwogu (2015) opined that due to the problems with manual voting systems in Nigeria, exploration for a more efficient voting system that is cost-effective and reduces electoral fraud is imperative. Extending this frontline of argument, Onu and Chiamogu (2012) urged that adopting robust IT policies and programmes are the most effective solutions to the problems of weak democratic institutions in Nigeria. The comparative advantage of e-voting over the conventional voting system according to them is obvious. The argument against manual elections is that elections in Nigeria have been controversial since 1964. Ballot boxes were frequently stolen, and those declared winners by the electoral arbiter were actually candidates that lost during the election (Alfred, Ngara & Nnadozie, 2018). In addition, missing names of some registered voters, intimidation and disfranchisement of voters, multiple and underage voting, snatching or destruction of ballot boxes, miscomputation and falsification of results were some anomalies associated with manual elections in Nigeria (Kuye, Coker, Ogundeinde Coker, 2013). The aforementioned suggests that it is only a computerized system that cannot be hacked

or conned that can convert the burdens inherent in manual voting to blessings for the Nigerian democracy. Nigeria needed a system that would allow citizens to vote freely while also ensuring that the results were fair. Therefore, this paper attempts to demonstrate that e-voting systems have inherent advantages over paper-based voting systems, and thus should be embraced in Nigeria. To achieve the above objective, the paper is divided into the following segments: conceptual elucidation, the flaws with conventional/manual voting in Nigeria, the imperative of transiting from manual to electronic voting in Nigeria, and the last section draws conclusions and recommends accordingly.

Conceptual Elucidation

Electronic Voting: Electronic voting (e-voting) is a system that allows voters to send their votes to election officials in a secured and confidential manner over the internet using electronic ballots (Oostveen & Bessdaar, 2009). Similarly, it can be defined as a system where the recording, casting or counting of votes in political elections and referendums involve information and communication technologies. It can also be seen as the use of information and communication technologies to record, cast, or count votes in political elections and referendums (IDEA, 2011). From the foregoing, e-voting is a system that enables a voter to securely and privately cast his vote for a specific contestant. Electronic voting is a comprehensive interconnected arrangement that uses a microcontroller to generate results based on public opinions. Electronic voting is of different types. Generally, e-voting can be divided into two main categories as can be seen in the diagram below:

Figure 1: Types of Electronic Voting



Source: Ashrit Laxmi (n:d)

Remote voting adopts mechanisms that allow voters to vote in ways other than casting a ballot in person at a polling station in their district of residence, whether they are abroad or within the country (European Union, 2018). Remote voting, therefore, is the type of e-voting that can be done in person at a location other than the designated polling station or at a different time, or by mail or proxy. Remote Internet voting according to HTET & AUNG (2014) is highly beneficial because it aims to increase voters' convenience and accessibility by allowing them to cast ballots from virtually any Internet-connected location. However, HTET & AUNG (2014) maintain that while this concept is appealing and offers many benefits, it also poses a number of security risks and raises other concerns about civic culture. They assert that the technologies that are available now and in the near future are insufficient to combat these threats.

Remote voting takes the form of Internet and SMS voting. "Internet voting" refers to electronic voting that takes place over the internet. France, Switzerland, and Estonia are the few countries that use Internet Voting for national elections (i-Voting) (Ashrit Laxmi, (n:d). On the other hand, short Message Service (SMS) voting is the process by which the electorates vote by sending SMS to a specific number. An SMS is sent using a mobile phone. For the poll site, voters can cast ballots from any polling location using Electronic Voting Machines (EVMs). The tallying process is quick and accurate, convenient and efficient. Security risks associated with such systems could be managed because election officials would have control over both the voting platform and the physical environment (HTET & AUNG, 2014). Australia, Belgium, Estonia, Brazil, Canada, France, Germany, India, Italy, Norway, Netherlands, Namibia, Peru, Philippines, Romania, Switzerland, United Kingdom and Venezuela, are countries that have used Electronic Voting Machines (EVM) in their national elections ((Ashrit Laxmi, (n:d).

A lot of benefits are accruable to the use of e-voting. In this regard, Benoist; Anrig & Jaquet-Chiffelle (2007) argue that traditional ballot handling, such as manual counting, is costly and time-consuming. Similarly, Cranor & Cytron (1996) affirm that the following advantages are associated with e-voting.

Table.1

curacy	ery voter has the urance that his or her lot will be counted. cast vote cannot be nged invalid vote will not be nted
mocracy	ly authorized voters are mitted to vote, ch voter is only allowed cast one vote.
vacy	cing a ballot to a cific voter is difficult.
rifiability	ery voter can check ether or not his or her e has been counted.

Source: Author's Construct, 2022

Reechoing the benefits of the e-voting tabulated in the above, Simon Batt submits that:

Ballots must be collected and counted from polling stations using traditional paper methods. This procedure takes a long time and causes the final result to be delayed. Election results could be available in hours rather than days if electronic voting is used. More people would vote if they could vote from home or at work. This preserves anonymity while encouraging the disabled and elderly to make their voice heard. Human counters can be replaced with electronic ballot-counting machines, and polling location employees can be replaced with internet voting. The infrastructure can be reused for each election, making it a one-time investment (Simon, 2019:2).

However, despite the numerous benefits associated with e-voting as can be seen from the foregoing, Geralach and Gasser (2009) contend that there is the risk that some people would be excluded from voting. Their argument is hinged on the fact that electronic voting may contribute to a growing digital divide in participation and knowledge between the skilled and knowledgeable and the poorly equipped and unskilled. By implication, this divides society into two groups: those who benefit from the convenience of electronic voting and the associated services, and those who do not. Apart from the digital divide, frequently perceived barriers are security and technological challenges which constitute barriers to internet voting implementation. Risks associated with technology, in particular, are into two classifications: (1) human-related and (2) technological-related.

Table.2

Human-related Risks	Technological-related ks.
ers' strong belief ıfidentiality regarding ir votes is guaranteed;	complexities of a vote ount requested by didates in the case of remely close election ults;
e use of remote internet ing is difficult due to dequate technical skills ong voters;	implementation of ventative measures to vent multiple voting;
ters who do not have or ire internet access may l discriminated against if ote internet voting is the y option available.	possibility of a system ck, failure, or loss of nectivity;
k of technical skills ong election officials, ich could result in them ing control or oversight key aspects of the Internet ing process;	sibility of distortion of e decisions and/or entire rnet voting system by uses or malware infecting ers' computers;
ere is a lack of nsparency when voters	difficulty in accurately ntifying the voter;
unsure if their votes are perly counted and stored;	
prospect of voting by xy is high. For example, nebody at home or at rk will interfere with ote internet voting in er to influence voting isions through fraud, midation, compelling ple to vote for mselves.	even Internet access ong socio-demographic ups (digital divide); as a ılt, internet voters may y account for a small portion of the electorate, wing voting results in our of specific socio-nographic groups.

Source: Adapted from Alexander H. Trechsel, Vasyl Kucherenko & Urs Gasser (2016)

In addition to the foregoing, it was reported in an empirical study conducted by Achieng and Ruhode (2013), that the lack of proper infrastructure and low resources to support e-voting implementation, particularly in informal settlements and rural communities, will make its adoption difficult. In the nutshell, the challenges associated with e-voting have discouraged some countries from using it. For instance, it was reported that: After several years of using electronic voting machines, the Netherlands decertified all of them in 2008 and switched back to paper balloting. Similarly, electronic voting machines were recently banned in Germany as well. Thousands of euros were spent on e-voting machines in Ireland, but they were only used in a few small pilot projects. Electronic voting systems have always been contentious in the United States and have sparked a heated debate between proponents and opponents (Achieng and Ruhode, 2013:4).

Despite the challenges, quite a good number of countries across the globe are leveraging on the benefits accompanying technological revolution to adopt e-voting and stay put with it. India and Brazil are leading the way (Kobie, 2015). In Belgium and the Philippines, electronic voting and counting technologies are also used in national elections. Electronic voting and counting technologies, including internet voting, are being tested in various stages by countries such as Estonia, Norway, Pakistan, and the United States (Achieng and Ruhode, 2013). In the nutshell, electronic voting and counting systems are gaining popularity around the globe as nations are using them to address a variety of issues related to the manual paper-based electoral process.

Democracy: The etymology of the word "democracy" is traceable to the Greek words' "demos" (people) " and "kratein," (to govern, to rule). Therefore, the term "democracy" is "government of the people" or "government of the majority." (Becker and Ravelosom, 2008). Consequently, where people maintain political sovereignty and apply it directly, democracy is being practised (http://en.wikipedia.org/wiki/Democracy). It was simply defined by Abraham Lincoln, a one-time President

of the United State of America as the government of the people, by the people and for the people (http://en.wikipedia.org/wiki/Gettysburg_address). This means that the beginning and the end of democracy are the citizens. The foundation of democracy is the right of all adults to have a say in public affairs as it affects them. This right includes, but is not limited to, the rights to volunteer for public service, run for elective office, and elect public officials by universal secret ballot by international "free and fair" standards. (Bassiouni; Beetham; Beevi; Abd-El; El Mor; Kubiak; Massuh; Ramaphosa; Sudarsono; Touraine; & Luis,1998). Voting is an important way for people to express this type of right. It is widely accepted in democratic societies and is thus used to express the willingness of a society to choose its leaders. Most importantly, voting contributes to the electoral process of a democratic country in determining the composition of its government. Thus, this study attempts to understudy the feasibility of adopting and sustaining e-voting in Nigeria to provide democratic dividends to the citizenry.

The Flaws with Conventional/Manual Voting in Nigeria

Nigerian elections have been conducted manually since the country's independence. This includes, among other things, voter registration, ballot papers, and voting procedures. The credibility of free and fair elections through these processes has been questioned as a result of a series of anomalies (Ishaq., Osman., & Jaleelkehinde, 2012). In the 2003 presidential election, for instance, human lives were lost. Similarly, during the 2019 presidential election, about 40 people were killed during the election including 11 in Rivers State (Premium Time, 2019). Herskovits (2007) reports that some 700 violent election-related incidents between November and March occurred where two gubernatorial front-runners were assassinated. Financially, a total of 444.5 billion naira (N444.5 billion) was spent by the Federal Government of Nigeria on the country's last three general elections, but over N255 billion was wasted due to low voters' turnout in each election (Datapyhte, 2022). A low turnout that might not be unconnected with fear of violence. The breakdown of the analysis is shown in the figure below:

Figure 2. Total Expenses Wasted Due to Lower Voter Turnout in Naira

Total Expenses Wasted due to lower Voter Turnout in Naira

Year	No. of Registered Voters (A)	Actual Voters (B)	Cost per voter in Naira (C)	Total Expense in Naira (D = A*C)	Actual Cost due to Voter Turnout in Naira (B*C)
2011	73,528,040	39,469,484	1,893	139,188,579,720	74,715,733,212
2015	68,833,476	29,432,083	1,691	116,397,407,916	49,769,652,353
2019	84,004,084	28,614,190	2,249	188,925,184,916	64,353,313,310
Total				444,511,172,552	188,838,698,875

Table: Dataphyte • Created with Datawrapper

Adapted from Datapyte, 2022

The INEC recorded 73.5 million registered voters in 2011. That year's election budget was based on an average cost of N1,893 ($9) per voter. This totalled N139 billion. A total of 116.3 billion was budgeted for the 2015 elections, at a rate of N1,691 or $8.5 per voter for the 68.9 million citizens who had registered before the election funding stage. Before the most recent general elections in 2019, the highest number of registered voters was recorded. The electoral commission registered 84 million voters and budgeted N2,249 ($6.24) per voter. This cost the country N189.2 million.

Besides the financial wastage, voters' time has been wasted during elections in Nigeria. Voters in Balanga and Yamaltu Deba local governments of Gombe State waited in vain for electoral materials and INEC staff to appear during the presidential election, but to no avail (Human Right Watch, 2007). In Federal Low-cost I polling unit in Gombe, Human Right Watch (2007) reported that the presidential election which was slated to start at 8:am, eventually commenced between 3:30 pm and 4 pm, and the residents claimed that not more than 130 people had voted by 5 p.m. However, official result sheets at the collation centre claimed that more than 900 votes had been cast in that short

period, 876 of them for the People Democratic Party (PDP) (Human Right Watch, 2007).

In Kaduna state, the collation of the presidential election in 2019 was hampered by the late arrival of materials and the incompetence of some presiding officers. The state governor, returned to his polling unit around 6 p.m. on election day to observe the ballot counting, but when he left at 9.30 p.m., the presiding officer was still battling to reconcile the figures (Premium Time, 2019). The 2019 election was characterized with the late arrival of materials, malfunctioning card readers, and violence (Premium Time, 2019). Closely related to what happened in Kaduna state, some polling units in Otukpo Local Government Area of Benue state had INEC staff arrive four hours late for the exercise, resulting in voting being carried over to the next day (Premium Time, 2019). The situation delayed the commencement of the election and eventually wasted voters' time in the polling units. Below is the evidence of time wastage during election in Nigeria occasioned by manual voting system.

Figure 3: Image of Time Wastage During Election in Nigeria

Source: https://www.premiumtimesng.com/news/headlines/343971-626-killed-during-2019-nigeria-elections-report.htm

In addition to the time wastage, manual elections in Nigeria have been characterized with rigging. The issue of rigging in Nigerian elections is historical. The post-independence elections in Nigeria marked the beginning of manual election rigging in the country's history (Obiefuna-Oguejiofor, 2018). There have been massive rigging, intimidation, oppression, violence, and indiscriminate killings. As a result of these pressures, the electoral process failed completely. After this election, the existing fragile peace could no longer be sustained, and the wanton rigging at the election ensured that the demise of the Republic was only a matter of time. This according to Nkasi, as cited in Obiefuna-Oguejiofor (2018), resulted in a three-year civil war and the country's worst humanitarian disasters. Similarly, the general public's perception of the 1983 election was that it was massively rigged (Apter, 1987). There were accusations and counter-accusations from the political parties of intimidation, manipulation of ballot papers, thuggery and fraud.

Likewise, during the 2003 presidential election, the polling station was tainted by stolen ballot boxes and erroneous vote counts (Herskovits, 2007). Professor, who was the returning officer in an Akwa Ibom state north-west senatorial election in 2019, was accused of falsifying results. The All-Peoples' Congress (APC) obtained 10,534 votes, while the PDP scored 25,123 votes. However, the accused declared a result in which the APC garnered 15, 534 votes and the PDP received 20,123 votes, resulting in 5,000 fewer votes for the PDP and 5,000 more votes for the APC (Channels Television, 2021). After pleas for mercy by the defence counsel and the accused, the judge ordered the accused to pay a fine of N100, 000 on the first count and sentenced him to three years in a correctional facility with no option of a fine. The common cause of these inaccurate results is vote-buying. This is opposed to the ethos and norms of democracy. Before the 2015 elections, for example, it was reported that during the All-Progressive Congress (APC) presidential primary in Lagos State, "over 8 000 delegates who participated allegedly earned US$5 000 each from the candidates." Delegates were to receive $2,000 from one presidential candidate's campaign and $3,000 from the other candidate's campaign. Given that over 8000 delegates were reported to have attended the primaries, the competing camps could have spent more than US$16 million and US$24 million on vote-buying during the primary stage, respectively (Matenga, 2016). Human Rights Watch observed that the Presidential election of 2007 was characterized with violence and intimidation that marred the electoral process in the states of Gombe and Katsina, denying a large number of voters

the opportunity to vote (Human Rights Watch, 2007). Voting was marred by late opening of polls, a severe dearth of ballot papers, obvious voter intimidation, hooligans snatching of ballot boxes, vote-buying, and other unscrupulous attitudes widely displayed where elections took place. With this background on the situation of manual election elections in Nigeria, it is imperative to seek digital solutions to remedy the above abnormalities that are asymmetrical to enduring democratic governance in Nigeria.

The Imperative of Transiting from Manual to Electronic Voting in Nigeria

In 2007, the desire to reclaim INEC's lost integrity, improve the veracity of election results, and exonerate INEC from public accusations of colluding with the ruling party to manipulate election results prompted the development of the Electronic Voting Machine (EVM) (Idris & Yusof, 2015). This is coupled with citizens' desire to elect credible and committed leaders for infrastructure development and the need to reduce post-election violence, which has claimed the lives of many innocent people in previous elections (Adebayo, Ugiomoh, & AbdulMalik, 2013). The burdens associated with manual elections in Nigeria range from the cost of paper ballot elections, with their massive logistics requirements, movements of multitudes of ad hoc voting staff and security officials, high-security printing costs to slow and ponderous counting, frequently open to manipulation and fraud, calls for a transition to e-voting for Nigeria. These necessitate the transition from manual to electronic voting. However, a series of debates have been trending for and against e-voting in Nigeria. Some argue that the remedy for abnormalities associated with elections cannot be tackled through e-voting (Vanguard, 2021). Those who argue against it used the case of the 2015 general election in Nigeria to buttress their position. For them, e-voting was pilot-tested during the 2015 general election and triggered national outrage and embarrassment when the then-president Goodluck Jonathan, his wife and mother could not be accredited at the polling booth for half an hour due to the malfunctioning of the Independent Electoral Commission (INEC)'s Smart Card Reader (SCR) (This day Newspaper, 2015). On the other hand, it is contended that e-voting holds greater promise as a panacea for voter fraud in Nigeria's electoral system if properly implemented and funded (Obiefuna-Oguejiofor, 2018). Those who argue in favour of e-voting for Nigerian aptly submit that the Kaduna state government deployed e-voting in the 2018 council election and it was successful (The Nation Newspaper, 2021). The success of the electronic voting tryout in Kaduna State has triggered the Independent National Electoral Commission (INEC) under pressure to use it in the next general elections, come 2023. However, the Nation Newspaper (2021) claimed that the Kaduna State local government elections that used e-voting were not subjected to independent verification and validation, hence, cannot be used to assess the feasibility of e-voting in the 2023 general elections. Substantiating the foregoing, The Nation Newspaper (2021) argues that "The ballot machine is a sensitive material." Unfortunately, opposition parties were not permitted to monitor or inspect those items to see if they have been tampered with. Thus, it was insinuated that some of the machines were preloaded. This equally accounts for the reason why it was rejected in western countries like Germany, Ireland, and the Netherlands. It was largely rejected due to opposition pressure. However, this was done without a concrete and comprehensive evaluation of the e-voting systems (Niemoller, cited in Uzedhe, & Okhaifoh, (2016). Notwithstanding, with the humongous benefits as obtainable in other climes, electronic voting is both feasible and practicable in Nigeria, and as such should be used in future elections in Nigeria. No doubt, the benefits that will accrue to the adoption and use of e-voting in Nigeria are innumerable. Huge burdens would have been lifted off the electoral process in Nigeria thereby leading to a stable democracy. Countries across the globe have utilized the e-voting system and many challenges with their electoral processes were reduced to the barest minimum. Summarizing the benefits of e-voting, Data-monitor (2008) opined that E-voting reduces costs, increased participation and voting options, increased the speed and accuracy of placing and tallying votes, and provides greater accessibility and flexibility to the disabled. Similarly, Okoro (2016) affirmed that the adoption of electronic voting systems is a significant process that is required for the improvement of election outcomes as well as the reduction of fraud and corruption associated with ballot boxes and ballot papers. According to a study conducted by Nnaeto and Anulika (2018) on e-voting and credible elections in Nigeria: A study of Owerri Senatorial Zone, 85 per cent of respondents agreed that the use of e-voting in Nigeria will reduce the rate of election fraud. This is due to the fact that most electoral proceedings will be powered by electronic means, leaving a small window for fraudulent manipulation. This affirms the finding of Ephias (2010), who opines that an electronic counting system was installed in the Philippines, and it deals with fraud during the counting process. However, just because it works in the Philippines does not guarantee that it will work in other democracies in the same proportion. Without mincing words, International Peace Institute (2011) affirms that a critical advantage of electronic voting is the elimination of human involvement in polling stations and locations arising during transmission, tabulation, and distribution of results. Similarly, Obiefuna-Oguejiofor (2018) echoed that with e-voting, Nigeria can overcome voting frauds, impersonation, multiple voting that constitutes a major step in restoring public faith in an electoral system bedevilled with challenges. For Professor Mahmood Yakubu, the Chairman of the Independent National Electoral Commission (INEC) of Nigeria, the Internet voting system tends to maximise user participation, by allowing them to vote from anywhere and allowing access from different

computers systems and from any device that has an Internet connection (The Guardian Newspaper, 2020). This is consistent with the viewpoint of Germann and Serdült (2014), who argue that the elderly, disabled, those living in remote areas, citizens residing abroad (expatriates), for whom it saves the return time associated with postal service are the categories of people the internet voting appeals to most. This is because they do not have the opportunity to vote at a polling station. In the same vein, Arent (1999) submits that it is accessible at any time and from any location – at home, at work, on vacation, or for business – and enables citizens to "vote in [their] underwear." But Norris (2001; 2002); Oostveen and Van den Besselaar (2004); Gainous and Wagner (2007) on the other hand, argues that e-voting will only benefit citizens (well-educated and wealthy) who are already familiar with the internet and vote on a regular basis, while leaving behind the less educated, the elderly, and women. Supporting this position, research conducted in Canada and Europe show that internet voters are typically older, wealthier, and better educated (Goodman, 2014, Serdult; Germann; Harris; Fernando; & Alicia; 2015). The key message is that internet voting is expected to increase turnout by providing an easy way to vote, but does not affect the turnout of only certain groups of citizens.

Another strength of e-voting closely related to the foregoing is that, it is capable of curtailing heavy election expenses. This is another critical dimension of reducing the burdens associated with elections. The cost-saving potential of an online voting system is limitless. Ballots are not required to be printed. Voters must simply complete and submit an online ballot. Citizens can also use “Follow My Vote” to ensure that their vote was correctly cast without needing a physical receipt. Voting machines, which are costly to purchase and maintain, have become obsolete as a result of online voting. Voting machines and software contracts and IT maintenance can cost thousands of dollars, and a single polling place usually houses several machines. Voting machines are not only expensive, but they are also vulnerable to hacking (https://followmyvote.com/cost-savings/). Similarly, Punch (2021), noted that since Nigeria already has a functioning biometric voter registration system and records, the costs of adapting the technology and perfecting bank-grade cyber security and data storage can be met at a fraction of the current INEC election budget. Punch (2021) re-echoed that the exorbitant cost of reprinting election materials to correct errors or comply with court judgments obtained after the materials were printed is immediately eliminated in an electronic voting process because INEC can simply correct online at any time before election day. Viewing the extent to which e-voting would cut costs for the Nigerian government, Prof. Adesina Sodiya, President of NCS, called for the adoption of an electronic voting (e-voting) system, which he claims will eliminate electoral fraud and cut election costs by 95% (Thisday Newspaper,2022). The perceptions above are not different from what obtains in countries that have been conducting their election through electronic voting over some decades. India for instance, has used relatively cheap EVMs for decades and has concluded that EVM-based elections are much cheaper than paper-based ones (https://aceproject.org/aceen/topics/em/emia/emia11/mobile_browsing). Specifically, India utilized e-voting in her 2004 election and installed 800,000 voting machines at $200 million. It was predicted that the authorities will save approximately 10,000 tons of ballot paper for every future election.

Regarding the time-saving dimension, Punch (2021) affirms that electronic voting will also end the inefficient practice of restricting movement on election day and bring our general population up to speed on technology use. This helps in reducing voter apathy caused by fear of violence, long lines, and queuing in inclement weather at polling places on election day. Without mincing words, Uzedhe and Okhaifoh (2016) posit that the traditional voting system with paper ballots used in Nigeria's electoral system is time-consuming and, in most cases, marred by irregularities caused by the system and/or human errors. Inconclusive election results, heated debates, and costly litigation resulting in further financial and time loss to the country are the aftermath of irregularities.

Conclusion and Recommendations

The electoral process in Nigeria has been characterized with a series of abnormalities. The abnormalities are antagonistic to the democratic ethos of good governance befitting of a modern country in the 21st century. The ugly scenario has been perhaps attributed to the manual-based electoral system that is cost-intensive, submerged in violence, electoral frauds, restriction of movement of people from one location, wastage of peoples’ time under the harsh weather, and many other unfair deals. The paper explores the feasibility of transiting from manual to electronic voting amidst some challenges associated with the electronic voting system. This paper demonstrates that the manual voting system has huge flaws as deduced from the documentary evidence. However, it concludes the Achilles heel of e-voting systems are tangential and cannot constitute tangible barriers to implementing electronic voting in Nigeria. Its inherent advantages over paper-based voting systems are overwhelming and thus should be wholeheartedly embraced in Nigeria. In view of the lacuna identified that it is capable of widening digital divide, the paper recommends aggressive sensitization and awareness creation that it is valuable to both the rich and the poor, the educated and the non-educated ones. Voter education campaigns, capable of effectively communicating the benefits of the internet voting procedure, the system's overall security, and clear instructions to voters on how to vote online, are required. A comprehensive study of Nigerian citizens' attitudes toward internet voting is required in order to assess the public acceptance of such a novel procedure and, more importantly, to identify citizens'

main concerns, which can then be addressed when the system is designed. In addition, the paper recommends the universal principle that: "you do not deploy a technology on a large scale without it being tested on a smaller scale". Therefore, the paper strongly recommends that the government of Nigeria should pilot-test the electoral digital solution at local or state government elections before spreading it to other levels of government.

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RESEARCH ARTICLE

A Review, Phyto-Electricity: Generation of Electricity From (Solanum Tuberosum)

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Abstract
Phyto-electricity is the process of generating or getting energy from green plants by using them as an electrolyte and inserting different metal plates in them to act as electrode in other to tap into the energy embedded in them and converting them to useful electric energy. Nowadays generating electricity from green plant has become very popular, but phyto-electric power generation has not been able to supply substantial energy to humans and this is due to the low electron in the plants used to generate electricity. In past research people have used trees to generate electricity. The phyto-electric power system works on same principle as the battery. In this design potato will be used as a source of power or as the green plant the battery which is filled with electrolytes, the more the electrolyte the higher the voltage that is readily available to be used, in other to be able to savor the power from the potato two dissimilar metals was used and the metals used were iron and zinc. After completing all of the paper design and analysis, the project was implemented, built, and tested to guarantee that it functioned properly. Electricity was generated and it was used to power a LED, the total resistance of the wire is 1Ω, there is also voltage loss across each node. This project was a success, but more research still needs to be done. And this project is a prove that energy are available in our surroundings, they are just needed to be investigated and further researched and there are more areas of energy and technology development that are yet to be addressed that are various problems faced by man in his day to day activities.

Keywords: Electricity; Phyto-electricity**;** Electrolytes**;** Power generation**;** Phyto**;** Plants

Introduction

A lot has been said about electricity generation in the world. Electricity generation is mainly about converting other forms of energy into electric energy. Research on electricity started in the early 1800s by Michael Faraday and his method is still used till date. Electricity generation for commercial use started in the late 1800s.

Over the years Nikola Tesla and Thomas Edison are part of the scientists that have made significant contributions in electricity generation. One of the main contributions of Nikola Tesla is the Alternating Current which is the best for distribution of electricity in households. Thomas Edison, one of America greatest inventors contributed the Direct Current which is used to power most electrical appliances in the world. An event happened in the course of history called the "The War of Currents" it was a debate between the Alternating Current and the Direct Current, argument on which is better, grew during the 1890s.

Over the years both movement of currents have been used in different areas in terms of electricity. Alternating Current is mainly used in electricity distribution in households, offices and so on while Direct Current powers most appliances. These appliances have a converter or rectifier that converts Alternating Current to Direct Current since they operate using Direct Current.

Power generation cannot be overemphasized, Electricity determines the civilization of a country, Electricity is important for the development of any country. Most of the developing countries and low-income countries in the world suffer from lack of sufficient power. Countries' economies are dependent on electricity. The world is dependent on electricity now, most of the things we do in our day-to-day life are now computerized which leads to the need of electricity. From our cars, to our home, to our schools and to our offices, everything is being run by electricity, there's always an ever growing need of more methods or ways to generate more electricity in the world.

The 2021 Texas Power Crisis, The State of Texas in the United States of America suffered a major power crisis in month of February 2021 from three winter storms, there was more than $200 billion in damages of property. The estimate of lives lost directly and indirectly as a result of the Power Crisis is between 200-700 lives. This Power crisis also resulted in food and water shortage and also heat needed during the winter. The power crisis showed the role electricity play in today is world.

Electricity also made provision for employment opportunities, In Nigeria, lack of sufficient electricity is the main problem that is slowing down the development of this country, most international investors don't want to bring their businesses in to the country because of lack of electricity and most investors know that it's bad for business.

With the role electricity plays in our day to day life in the 21st century, Research and Development on generation of

electricity should be more focused on, in other to prevent events like The 2021 Texas Power Crisis, because the main reason or purpose there is science is to make the world a better and an easy place to live for mankind, we can only do that through more research in electricity generation.

Literature Review

Phyto-Electricity (Plant Power)

This is the method of extracting energy from green plants by using them as an electrolyte and inserting various metal plates into them to act as electrodes in order to tap into the energy stored in them and convert it to usable electric energy. Nowadays, it is highly popular to create electricity from green plants, however phyto-electric power generation has not been able to provide significant energy to humans, of owing to the low electron content of the plants utilized to generate electricity. People have used trees to create power in the past, such as in the study below. This paper is talks about design and construction of a phyto-electric power system to power an electronic device. The objectives are as follows:

1. Design and construct system to generate electricity from green plants.
2. Design and construct a circuit to be powered by the energy generated from the green plant.
3. Design and construct a circuit to measure the power, current and voltage generated by the green plant.

Methodology

Principle of operation of Phyto-Electricity

The phyto-electric power system operates similarly to a battery. In this design, the potato will be used as a source of power or as a green plant the battery which is filled with electrolytes and the electrolytes have electrons in them, and the potato has electrons in it which give our body a source of nutrition, then this source of nutrient is used as an electrolyte, the higher the voltage that is readily available to be used, and in order to be able to savor the power from the potato two dissimilar metals were used. The electrons divide into two distinct poles once the iron and zinc are plunged into the potato.

1. Cathode
2. Anode

The anode is obtained from the iron plate, whereas the cathode is obtained from the zinc plate. The potato was connected in series in order to get enough power to power any appliance or equipment. To achieve a larger voltage, the potatoes will be connected in series. A small potato living checker will be created utilizing a microcontroller in order to tell if the potatoes have aged and are unable to provide adequate electricity.

The components that will be used are listed below.

1. PIC16F88.
2. 9v battery.
3. LCD (Liquid Crystal Display).
4. Potato.
5. Iron nail.
6. Zinc (nail).

PIC16F88 - The pic16f88 is an 8-bit microcontroller with 18 pins (Figure 3.1a) that operates on TTL (Transistor Transistor Logic), which means it can operate between 5 and 5.5 volts and is programmable. The Microcontroller is a complete computer on a single chip that can accept, process, and output data, as well as having a ROM and RAM. In PIC16F88 devices, there are two memory blocks. The program memory and data memory are the two types of memory available. Because each block has its own bus, access to all of them can happen at the same time on the oscillator. General-purpose RAM and Special Function Registers are two types of data memory (SFRs). The SFRs that regulate the "core" are explained in this section. The SFRs that control the peripheral modules are discussed in the section that discusses each peripheral module individually. There is also data EEPROM memory in the data memory region. In other words, an indirect address pointer indicates the read/write address of the data EEPROM memory.

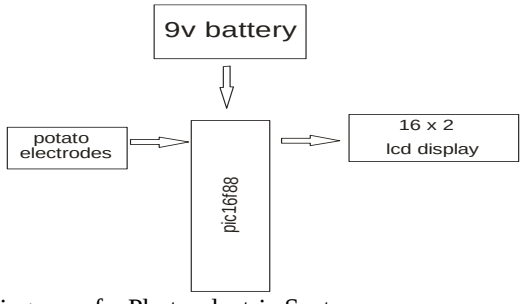
9V BATTERY - The 9 volt battery was used to power the microcontroller in other to tell the power level remaining on the potato.

LCD (Liquid Crystal Display) - The LCD was used to display all the parameters to be displayed to the user 23 and the LCD used was a character LCD 16x2

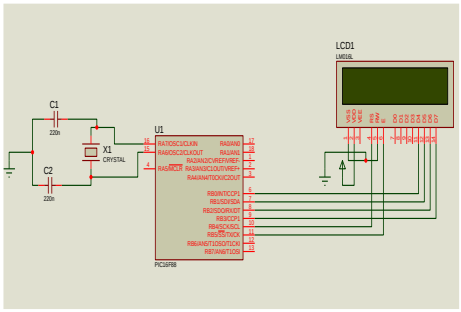
POTATO - The potato acts as an electrolyte, supplying energy. Potatoes were chosen because they are the world's fourth most prolific food crop and are grown all across the planet, including the tropics and subtropics. But, in addition to being high in phosphoric acid, potatoes are great because they are made up of durable starch tissue. Additionally, boiling the potato reduces the resistance in the dense flesh, allowing electrons to flow more freely, resulting in a considerable increase in overall electrical output.

IRON NAIL - The iron nail serves as the positive electrode used to savor power from the potato.

ZINC (NAIL) - The zinc (nail) was used as the negative electrode to savor power from the potato



Block Diagram of a Phyto-electric System

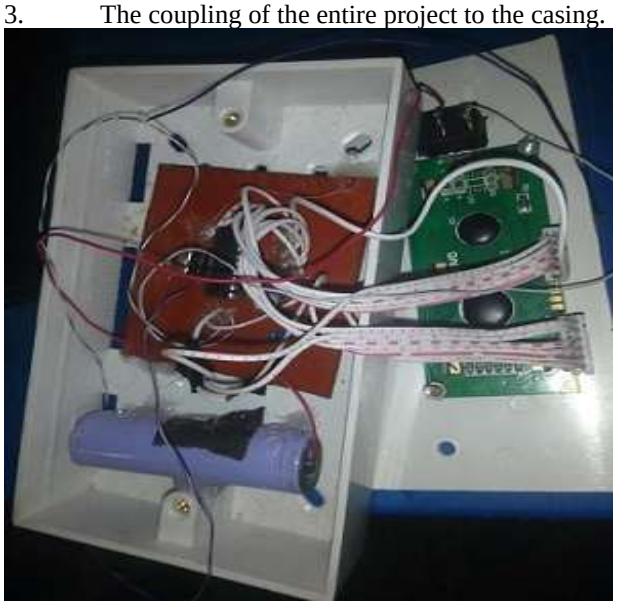


Circuit Diagram of the Phyto-electric System

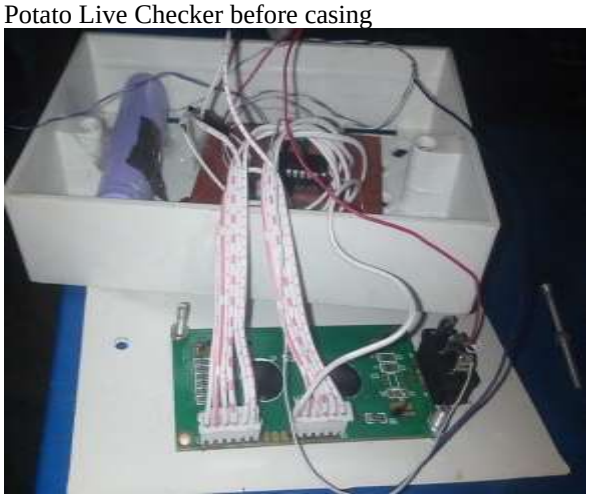
Construction

After carrying out all the paper design and analysis, the project was implemented, constructed and tested to ensure its working ability. The construction of this project was done in three different stages.

1. The implementation of the whole project on a solder-less experiment board.
2. The soldering of the circuits on printed circuit boards.
3. The coupling of the entire project to the casing.



Potato Live Checker before casing



Potato Live Checker before casing and boxing

Potato Live Checker and the circuit boxed and cased

Testing

The potatoes were plugged into the electrodes and the output power was first measured and corrected to 5v using voltage regulator after which it was used to power appliances (LED). **Oscilloscope**: To examine the rippling in the power supply waveforms and check that all waveforms were proper and their frequencies were accurate, an oscilloscope was utilized. To verify correct oscillation at 8MHz, the waveform of the oscillation of the crystal oscillator utilized was monitored.

Digital Multi-meter: Voltage, resistance, continuity, current, frequency, temperature, and transistor are all measured by a digital multi-meter. The process of putting the design on the board necessitated the measurement o f components' voltage, continuity, current, and resistance values, as well as frequency measurements in some situations. The output of the voltage regulators used in this project was checked using a digital multi-meter.

Results and discussion

After stacking the potatoes together power was available and also after using a boost converter board on the stacked potatoes we were able to light up an LED.

28 potatoes were used in total. And all 28 potatoes were connected in series to double the voltage and compensate for the voltage loss across each node.
7 potatoes par track.
2 track per phase.
28 potato stack in total...
Each line gives 0.3V minimum.
Total voltage = 28x0.3 = 8.4V.
When the led turns on the voltage drops to between 2V and 3V.
Total resistance of the wire =1Ω.

Total current in the circuit before load is placed on the circuit:
The total current of the whole circuit could not be measured3. because it is very low possibly in milli or micro ampere that is why we mainly concentrated in boosting the voltage of the circuit.

Conclusion

This project which is the generation of power from green plants was a success although still needs more research, this designed proved the fact that energy is readily available in our surrounding and only needs to be investigated into in other to be able to get more power or generate more power.
Stable power has always been a problem, particularly in African countries, particularly Nigeria. Scientists have attempted in the past to generate electricity from various power sources, one of which is phyto-electric power system design, but the design has not been capable of delivering sufficient power to humans. Living plants convert solar energy into organic compounds, of which 40% or more can be released into the soil, according to the concept of renewable energy production. Electrochemically active microorganisms that employ the anode of a fuel cell as an electron acceptor can oxidize the released organic molecules. At the cathode, the electrons are converted to water by oxygen. Without harvesting the plant, day and night electricity may be produced sustainably from biomass. This allows for the production of economical electricity anywhere that plants can grow. This is not really a European problem. It also provides prospects for poor countries and isolated areas. This challenge inspired the creation of this project design, and with it, we hope to create a prototype that can be enhanced in the future to generate power from green plants t o power electrical devices. As new generations of technology become available, it is necessary to review what is and is not possible in terms of a source of energy and power generation.
For most applications, tree power is unlikely to replace solar power, but it could give a lowcost option for powering tree sensors that detect environmental conditions or forest fires. Instead of cutting down trees to make room for solar infrastructure or connecting wires from towns across the forest to monitor tree health, environmental conditions, o r forest fires, the electronic output might be utilized to measure a tree's health. It can be utilized as a power source in distant places without access to electrical grids, such as most of the world's cities. This study could open the path for further novel and unconventional energy sources.
For the purpose of the future research, the project work can be improved upon. The following areas were highlighted for this purpose.

1. The whole circuitry can be improved on to generate more power.
2. Moreover, it is recommended that students should be enlightened on new areas of technology that are yet to be addressed in order to bring solution to the various problems faced by man in his day to day activities.

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RESEARCH ARTICLE

Using Science, Technology, and Innovation (STI); in Achieving Sustainable Development in Developing Countries (DCs)

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Abstract
University-industry relations need to be strengthened; several institutions have technology transfer offices that assist in the formation of spin-off companies. On inventions and technologies, different commercialization routes, the functions of technology transfer offices, and diverse organizational structures will be examined. By showing current innovation and technology, this paper contributes to attaining sustainable development for developed nations by academic and agricultural industry report, development, and commercialization operations. This research aims to analyses and completely examine the scientific and technical literacy approaches for sustainable development in industrialized nations. The evident necessity of sustainable development on supporting scientific and technical advancement in the world's "developed," "developing," and "under-developed" countries is obvious. In this research, we look at how most countries maintain scientific and technical progress. The study also looked at the ideas that underpin the implementation of scientific and technical literacy, with a focus on sustainable development. As a result, proposals on how the Federal government or other agencies may promote sustainable in terms of science, technology, including innovation were made.

Keywords: Science; Technology; Innovation and Sustainable development

Introduction

Another vexing conundrum despite the continuous technological revolution, the majority of the world's population continues to live in abject poverty, with insufficient food, shelter, and electricity, and is afflicted by diseases that might be readily treated if clean water and basic pharmaceuticals were made available. Fortunately, a big number of erstwhile "developing" nations are now on the verge of development, thanks to technical transfer and breakthroughs that have benefitted and continue to benefit substantial segments of their people. Countries like China, India, Korea, Taiwan, Singapore, and, to a degree, Brazil, have pursued their own technical paths. However, the uses of technology remain a pipe dream for large areas of Africa, Asia, but also Latin America, despite the fact that new technologies such as photovoltaics, cellular phones, and indeed the Internet might help them "leap-frog" into the twenty-first century's technological development (Vergragt, 2006). “Development is frequently connected with diverse countries' scientific and technical breakthroughs. The so-called 'developing' nations of Africa may achieve progress, but the primary challenge is maintaining that development.” (Ojimba, 2003).
The persistent contradictions between better lives for the wealthy few created and supported by technology to increase environmental degradation and deprivation for the large majority necessitate a deeper exploration but also understanding of the nature of technology but also its partnership to society, particularly in the context of developing a sustainable, innovation, and creative society (Vergragt, 2006). In the context of efforts to accelerate a massive transition to a more sustainable global society, which will entail significant shifts in culture, beliefs, consumption patterns, governance, industry, and institutions (Raskin et al., 2002), the topic of technology's involvement becomes much more serious.
Technology has been at the forefront of development for centuries transitioning between different stages, passing through industrial ages to our now current technological age. The continuous innovation of technology is what led to the bringing of new products, processes and services enhancing good life to all citizens both rich and poor (Vergragt, 2006). Most of the products used in modern life are products of science; technology and engineering originating from resources extract and processed in industries (Kongoli, 2016) making Science, Technology, and Innovation an essential part of development.

Aim and objectives

The major goal of this article is to look only at sustainable development of rich nations and see how science, technology, including innovation might help developing countries attain the same or greater sustainable development. The following are objectives of the study:

1.To study the economic growth of the developing countries via the development and implementation of STI capacity.
2.To study the resources extracted and processed in industries making Science, Technology, and Innovation an essential part of development in developing countries.
To study the challenges for developing countries which will help in enhancing their ability to learn, adapt, and disseminate current and new information and technologies in order to promote equitable and sustainable development.

Literature review

According to (Calin S. Vac and Avram Fitiu, 2017), "We believe that these obstacles are natural, owing to the formation/deformation of every professional and psychological character over time, which is heavily impacted by the peculiarities of their own workplace. These hurdles result in communication and comprehension mistakes, which impedes the development of technology transfer initiatives and results in increased time and/or money expenditures, as well as the failure of expected output or outcome indicators. Based on the experience of a projects implemented inside the CPMTT and the effects propagated around them at the institution level (improving the mentality and education of our researchers via training and improvement projects in order to maximize their efforts but also yields on their areas of competence, but the use of Sustainable development like a catalyst institution in triple helix, their individual impressive results, but also by the institution—at a general level), We specify even a well sustainable development facilitates between both environments players, trying to make the activities compatible with one another and ensuring that all the indicators performed within the project are met, maximising the impact in the Economic and Social environment through specialised technology transfer services in solving societal problems, specifically in the field of agriculture)."
According to (Philip J. Vergragt, 2006), "We have attempted to demonstrate that steering technical progress in the path of sustainability through social helmsman ship is a difficult endeavor, as well as to suggest what is necessary to take it on. It asks for a shift in scientific attitudes, improved public awareness, the development of improved monitoring and forecasting systems in academia but also government, and, most significantly, a higher priority put on corporate social responsibility. Above all, it demands that the factors that are driving scientific and technical innovation—funding systems, military and economic interests, and consumers—be changed. It advocates for more openness in scientific and technology companies, so that society actors may better monitor, appraise, foresee, and influence changes early on. It advocates for fresh and comprehensive ideas of the scientific and technical underpinnings of a future society that is both sustainable and appealing, as well as one that meets human wants and desires. It advocates for back cast and social experimentation, as well as innovative government models."

According to (Trade and Development Board, 2018), "The 2030 Agenda for Sustainable Development calls for a transition that will be impossible to achieve without a concerted effort to bridge the technical divide between developed and poor countries. Technology and innovation must contribute to the economic, social, and environmental components of sustainable development. Policy frameworks for science, technology, and innovation (STI) will need to take into account new social concerns, engage new players, explore larger conceptions of innovation systems, and employ different ways to innovation. This note offers suggestions for how those new policy frameworks might be defined, as well as changes that might help align UNCTAD technical cooperation inside this area, such as the STI program review, also with Sustainable Development Goals, for consideration by the Multi-year Expert Session on Investment, Innovation, and Entrepreneurship for Constructive Capacity-Building and Sustainable Development."

Science, technology, and innovation (STI)

The rapidly evolving and continuous dramatic growth in development over the last 20yyrs is the result of combining science-technology-innovation system in a wide variety of social and economic objectives (Freeman et al, 2009). "Some developing countries have achieved significant economic growth through the creation and deployment of STI capacity" (UN, 2015).
The role of STI if implemented properly will promote the achievement of sustainable development. This role should include a full spectrum including women, young people, and indigenous communities.
"Political situation and well-functioning universities, an educated workforce, sensible research and education infrastructural facilities but also linkages among public and private innovation actors, enterprises dedicated to research and development, and a stable intellectual property rights (IPRs) structure are all necessary components of a well-functioning STI ecosystem." (UN, 2015)
In developing countries, it is not just about implementing STI system in achieving sustainable development, another important aspect is the processes that will support and pave the way for the ability and involvement of individuals, businesses, firms, enterprises communities etc. STI system should penetrate and be implemented through different sectors such as health, agriculture, nutrition, marketing, management, and finance which will be drivers in achieving sustainable development. With the participation of this broad-spectrum, innovation capacity will gradually increase, leading to sustainable productivity and development.

However, developing nations' major innovation challenge is to improve their ability to learn, adapt, and disseminate existing and new information and technology in order to achieve sustainable and equitable growth. Exploiting the potential of newer technologies necessitates a learning and innovation-friendly environment. Developing nations should dedicate money, time, and concerted efforts to building and managing strong national innovation systems in order to gain more advantages from innovation (UN, 2018).

Social barriers affecting technological developments

Science and technology, according to seventeenth-century intellectuals like Descartes and Bacon, opened the keys to mankind's control over nature, something they considered as synonymous to human progress. The triumph of science and reason over superstitions and religion has been connected with the development of science and technology since the Enlightenment. Technological innovation always thrived because of knowledge based on observable observations but also rational thought. Technological innovation has long been associated with modernization and modernity.

From criticism of its reductionism through critics who underline those scientific truths are just as socially produced as a reflection on natural principles, the assumption that science represents reality or even ultimate truth has been questioned in numerous ways (Latour and Woolgar, 1979). Kuhn (1962) provided the framework for opposing logical positivism in his book The Structure of Scientific Revolutions, wherein he claimed that theories and facts had only meaning within a prevailing "paradigm." Latour and Woolgar (1979) Then, in an anthropological analysis of a modern scientific lab, he demonstrates how scientific truths are "socially produced" by scientists' interpretations of scientific measurements. As a result, the concept of "objective scientific truth" has been debunked. Following this study, the SCOT (Social Construction of Technology) hypothesis de-mystified technology (Pinch and Bijker, 1987; Bijker, 1995).

The concept of technology having undesired or unanticipated repercussions is equally new. Although the Luddites of such early nineteenth century broke machinery they saw as a danger to their jobs, and the Romantics condemned the dehumanising march of industrialization, it wasn't until the mid-nineteenth century that widespread fear of and opposition to technology emerged. Many individuals questioned the nature of individual scientist's ethical obligation after the atomic bombings of Hiroshima and Nagasaki unleashed immense carnage. To what degree is the scientist liable and responsible for the unintended and frequently unintended outcomes of his or her work? The idea of a self-evident relationship between societal growth and technical innovation has been called into doubt since then (Carson, 1962).

Decision-making on new technologies

Technologies co-evolve with societies (Saviotti, 2005), Technological advancements have an impact on society or vice versa. Who makes decisions on the development or direction of technological advances is a subject that is seldom posed and much less frequently answered. In the 1960s and 1970s, problems regarding expected and unforeseen repercussions, as well as the path and guidance of technological advances in science, technology, and society studies, technological prediction, and technology evaluation, were increasingly raised in academic circles (Smits and Leyten, 1988), technology policy, and appropriate technology (Vergragt, 2003). Military and business planners utilized most of these studies to better foresee and analyses the ideal courses of future technology, while others were employed to warn against potential disasters. The 1972 Club of Rome prognosis of an impending energy shortage and the potential of fossil fuel depletion is a well-known example.

Science and technology's evolution from tools to an all-encompassing culture appears to have disguised problems concerning their helmsman ship, particularly the potential of democratic choice directing them. Such questions were also obscured by the prevalent history and philosophy of science and technology (empiricism and logical positivism) that emerged in the 1930s, which claimed that scientific innovation is driven by innate human curiosity but that scientific discovery leads "automatically" to current technologies and commercial deployment.

Achieving sustainable development

Government

Government at all levels rank high among the most important drivers" (Verg, 2006) for achieving sustainable development. With proper embracement of the STI system especially in the fields of IT, Government is more qualified to be transparent and less prone to corruption. Therefore, it is important for the Government to realize and support all sectors of its country in the use of STI in achieving sustainable development. If the Government is on-board firsthand, its citizens will find it easier to transition and cope with technological changes making it sustainable and productive.

Government has the capacity to enforce strategies that will benefit its citizens in adapting to various trends in technology field ranging from health, finance, management, and nutrition. The government can build industries and support companies that will embed and standardize STI in its mission of sustainable development. The absence of Government will make achieving sustainable development using STI to have less impact, slow propagation and eventually lost its sustainability. Therefore, Government support cannot be overemphasized and is of high priority to the achievement of sustainable development.

Education and communication

There is a need for revolutionizing the education system of developing countries toward STI. Youths are the backbone of every country, especially in development. If the education system the youths are undergoing doesn't support sustainable development, the country will still be in the same place.

"The history of technology, cultural differences in technology, social forming of technological artefacts, societal processes and choice structures that frame technological innovations, and the repercussions of technology for society must all be taught in ways that engage learners in a greater knowledge of technical progress processes."
The education system should connect culture, history, government, economy, and social values with STI. With this, a developing country will produce focused minds ready to lead it into achieving sustainable development.
Furthermore, considering mathematics is the foundation of science and technology, its level of understanding among developing countries needs to be elevated. There is a need to boost students love for mathematics; teachers to diversify their approach of teaching (Vac, S.C et al, 2015) all with the intention of sustaining scientific and technological development which will lead to achieving sustainable development.
Technology transfer among institutions and industries may accomplish a lot. "A collection of techniques that encourage overall transfer of new ideas, information, technologies, practises, and/or talents from one context to another," defines technology transfer" (Vac, S.C et al, 2015). "Technology transfer is a process of designating the official transfer to industry of discoveries coming from universities or detailed review, for commercial reasons in the form of new goods and/or services," according to the Organization of University Technology Managers" (Vac, S.C et al, 2015).
The most important factor in the success of technology transfer is the academic researchers' (Vac, et al, 2017). There is a need for relevant bodies to come together and establish a sustainable process through the Technology Transfer Office (TTO) to ensure positive mutual benefits between institutions and industries. Institutions and Industries should establish a proper understanding that will allow students to gain practical hands-on knowledge and industries to gain academic insight researchers. These way developing countries will reach a successful sustainable development.

Linking strategies

Developing countries should be able to review their existing strategic plans and be able to link it with trending STI framework addressing challenges, interventions, priorities, goals, and policies that will allow smooth transition among all sectors responsible for achieving sustainable development using STI. They should come up with strategic plans that will meet "human needs and aspiration for freedom, belonging, and self-realization fulfilment as much as possible" (verg, 2006; Stutz, 2006). By looking into trends and development projected on how the future might look like and how they might get there, with this projection they can be able to determine their vision and build on it.

Self-organizing group

Citizens can organize themselves in ways that will foster the public good (Verg, 2006). These organizations are known as; Nongovernmental organization (NGOs), Self-Organization Groups (SOGs) are organizations that gain national and international recognition. They exist to address, solve, mitigate, or intercept issues that seem to be of concern in a community. These organizations can have an impact on the promotion of sustainable development in a country. Self-Organizing groups can gain influence within and outside a country thereby deriving the necessary strategy in promoting STI and achieving sustainable development.

Interaction

Like-minded people from different cultural and economic environments are already linked via the internet. This way so much can be achieved through discussion and interaction between experts in various fields of technology.

There are experts in the field of Artificial Intelligence (AI), Information and Communication Technology (ICT), Nanotech, Biotech etc. that are willing to help with resources to individuals ready to obtain them. By encouraging citizens and communities in tapping into these resources, developing countries can utilize this advantage and benefit from it thereby immensely saving effort and cost.

Business

Depending on the size of the business, whether \Multinational Corporations (MNCs) or Small-Medium Enterprise (SMEs) a business can decide to promote and implement sustainable development through STI within its business operations. Business can also contribute to its society by investing in research and development that will bring sustainable development in its environment. Stakeholders and entrepreneurs can orient business operations towards a standard that will enhance "environmental and Social Sustainability that will benefit its environment.

"Technological innovation is described as effectively bringing goods and processes to market that meet citizen-customer sustainability demands while also generating a modest profit for the company" (Verg, 2006). In this current era, businesses are already understanding and

accepting the role of STI in reducing cost, boosting productivity, and ensuring sound profit, however, stakeholders should realize it's not just about them, its more about how much sustainable development they can achieve together with its society.

Other programmes

Government, Stakeholders, Self-organizing groups, and other able sectors should be able to come up with creative programs that will promote sustainable development through STI. Programs such as workshops, TV shows, adverts, competitions, presentation etc. that will be done publicly or privately through media or at schools, workplace, markets etc. that will create awareness to the citizens of the country. Considering how media has dominated communication, it is a good channel that can be used in addressing issues of STI and fortifies the understanding of masses in achieving sustainable development through STI.

Discussion

As we can see, the "correct way" is not predetermined. It will include components such as a "good life" with "well-being" for everyone now and in the future, with protection of the Earth's biosphere, the eradication of poverty and associated health and housing issues, a sustainable agricultural and food system, and employment and leisure for all. If the correct drivers, institutions, and steering mechanisms are in place, technology may be able to assist in achieving this goal. In the second and last section of this essay, we'll look at "how to get there" and what mechanisms can aid society in developing the "correct" technology. Cultivating these conditions could serve as a springboard for building local, regional, and global policies and actions aimed at specific audiences in research, business, government, and non-governmental organizations. A call for a research and activity agenda backed by a group of devoted scholars, researchers, and activists might be the next logical step. When employing helix models to investigate innovation (ecosystems) and their growth with an emphasis on Civil Society participation, each region's innovation performance is purely reliant on the importance and growth of each sphere, and the strength of connection among them. As can be seen from the examples above, well-defined sustainable development could indeed drive innovation, promote new products, make it easier to commercialize research results on the industry, and generally enhance the overall transfer of technology process via all networks (program management, services, associative systems), thereby contributing towards both scholarly and agricultural industry study development. In fact, by solving societal needs and involving Society through open innovation eco-systems, a well-defined sustainability can bring but rather prove its advantages in the quadruple helix, and is the reference strategy for the preparation of Innovation Techniques for Smart Specialization.

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RESEARCH ARTICLE

Introductory Technology as it Impacts Modern Society in the World (Nigeria as a Case Study)

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Abstract
Technology may be defined as the tangible and immaterial things created either by application or mental and physical work in order to achieve a goal. Technological education, from the other side, does not concentrate on a certain job path but rather on providing fundamental technical skills. As a result, while all technical education programmes are technical in nature, not all technical education programmes are vocational in nature. This subtle relationship explains the interchangeable usage of both names in scholarly literature. According to Nigeria's national education plan, technical education is focused on the development of highly technological human resources with the goal of producing a national pool of skilled and self-sufficient artisans, technicians, including technicians in technical and vocational fields. Education is just a "par excellent" tool for national development in the world. Non-governmental groups, communities, and people have all actively participated, as has the government. As a result, it is vital for the country to articulate clearly and unequivocally the philosophy and aims that motivate its investment in education. That was what the National Education Policy wants to achieve. According to the study's findings, one of most endemic difficulties militating against participants' performance throughout introductory Technology are really a lack of training infrastructure, a shortage of teaching staff, insufficient discovering, a vast curriculum, poor appreciation and compensation, as well as inefficient guardian and counseling center.

Keywords: Technical; Material; Introductory

Introduction

Technology is a collection of techniques, skills, methods, and processes that are used in the production of products and services, or the pursuit of objectives like scientific research. Technology can be described also as knowledge of procedures, processes, and such, or it can be encoded in machines that allow them to be operated without a complete grasp of how they function. The most fundamental type of technology is the creation and usage of fundamental tools. The Neolithic Revolution and the prehistoric discovery about how to manage fire increased food availability, and the invention of the wheel made it simpler for humans to move and control their environment. The printing press, the telephone, and the Internet are examples of historical developments that have reduced physical barriers to communication and allowed humans to engage freely on a worldwide scale. There are numerous effects of technology. It has fostered the emergence of the leisure class and the development of much more contemporary economies (particularly today's global economy). Many technological processes produce undesirable by-products, like pollution, and resource depletion, both of which impair the Earth's environment. Innovations always had an influence on a social standards and have resulted in new ethical issues. Only two examples are the creation of the notion of efficiency of human production and questions of bioethics. Philosophical debates have emerged on use of technology, including disagreements over whether it improves or exacerbates human conditions. Neo-Luddism, anarcho-primitivism, and other reactionary movements decry technology's pervasiveness, claiming that it harms the environment and alienates people; proponents of transhumanism and techno-progressivism, on the other hand, see continued technological progress as beneficial to society and the human condition (Liddell et al, 1980).

Technical education, on either hand, facilitates the acquisition of practical and applied skills as well as basic scientific knowledge. Technical and vocational education in the world has had a stormy history. Because of its shaky origins, educators in general misunderstood this aspect of education. On a conceptual level, educators struggled to differentiate between technical and vocational education, while society was taught to believe than vocational education is solely for those unable to complete academic programmes. In this context, technical - vocational education has grown steadily from its beginnings to the current day (UBE, 2001).

Technical personnel training in the world has faced several challenges, including policies unassociated to our

problems, curriculum with no linkage to workplace and social needs, misappropriation intended for academic reform, lack of job satisfaction, insufficient facilities, inadequate funding, brain drain, poor training staff, bribery, and corruption. Again, technical education makes a significant contribution in areas such as electrical and electronics technology, metal work technology, mechanical/automobile technology, building technology, and woodwork technology, among others. Technical education is a practical-oriented education that is distinct in its content and approach, requiring special attention. Digital technologies are fast expanding, presenting new opportunities as well as new threats for our society, 1 and organizations of all types are hurrying to adapt their plans and activities in response. Corporations and governments were restructuring in order to enhance output, improve quality, and reduce expenses. Entire sectors have been reinvented to better fit the digital era's reality. It is not an exaggeration to say how information technology is fundamentally transforming people's knowledge interactions. In terms of our nation's capacity to preserve a healthy democracy and economy, the information age has significantly raised demand in university-level education; lifelong learning is indeed a private and a societal benefit. However, while information technology has the potential to improve and enrich teaching and research, it also looks to offer some risks to our schools and universities (Katz, 1999; Duderstadt, 2000) in their present incarnations We can now give educational services to everyone, anywhere, at any time, thanks to sophisticated computers and networks. Technology has the potential to generate an open learning environment in which the student evolves into a more active and demanding consumer of educational services, no longer obligated to make the journey to a specific location to participate in a pedagogical process involving deeply integrated studies based primarily on lectures or seminars given by local experts. Faculty intellectual communities are likewise moving away from physical campuses and toward virtual ones that are dispersed throughout cyberspace. Furthermore, technology improvements are propelling the creation of new for-profit rivals as well as the establishment of large markets for educational services, both have the potential to revolutionize the higher-education business (Goldstein, 2000; Shea, 2001).

Prior to the establishment of a 6-3-3-4 system, this was recognized while our schools' curriculum were just too wide intellectually yet failed to meet the requirements and ambitions of the country. Rather of generating job creators, the system created job seekers. The 6- 3- 3-4 method was created in 1982 in response to a demand for a realistic curriculum that would meet the nation's requirements and ambitions. The curriculum includes pre-vocational topics including such basic technology, home economics, and business education that are required in Junior Secondary Schools. Woodworking, metallurgy, basic electricity/electronics, building construction, technical drawing, plastic and rubber technology, and auto/mechanical work are all covered in beginning technology. The foundation for the learning of core technical skills and knowledge is laid forth in introductory technology. If students are unable to pay for their education after Junior Secondary School, the skills as well as information learned at this level will help them to be self-sufficient, which is incredibly valuable. The 1969 National Curriculum Conference, which brought together a diverse group of Nigerians, highlighted the necessity for a national education strategy. The meeting was called in response to widespread dissatisfaction with the incumbent educational system that have grown isolated from national needs, aims, and ambitions. In 1973, a conference of professionals representing a number of members in the world interest organizations was organized in response to the National Curriculum Conference. Representatives from non-governmental organizations and other groups attended the conference, which focused on what a national education strategy for just an independent and sovereign the world should seem like. After gathering comments from states and other interested parties, the seminar created a draught paper, which has become the final document, the National Policy on Education, which was first published in 1977 (NPE, 2004).

Technical education in some part of the world

According to (Uwaifo, V.O, 2009), technical education is the education of technically minded individuals who could be the catalysts, facilitators, as well as implementers of a country's technological advancement. He believes that teaching the populace about the need of being digitally literate would ultimately lead to self-sufficiency and sustainability. He argued that technical education, more so than any other profession, has a direct influence on the country's prosperity. Because of technical education's inability to successfully employ scientific concepts to promote technology, some part of the world's poor rate of industrialization and technological growth might be related to a growing gap between science and technology. This suggests that some part of the world's technical education programmed should be revamped. The overhauling of curricula may not necessarily result in the production of highly literate technical education experts or ready-made graduates for industry, which may result in rapid industrialization or economic growth of the country, unless solutions are proposed to some constraints that may militate against positive outcomes, but it will adequately equip our youths with the relevant skills needed for their daily lives. Technical educators face the most difficult task in persuading legislators that the programme deserves priority attention in resource allocation. Many strategies for achieving favorable results have been promoted at various fora, such as lobbying, participation of technical educators in governance, wooing, and so on, but the

government continues to take a skewed approach to the program's proper growth in the world. It is impossible to overstate the importance of technical and vocational education in driving economic growth. Without an army, no country can wage war. Similarly, without well-equipped technical and vocational schools, some part of the world will not be able to thrive. It is a gap in some part of the world's development strategy (Duke, V.E, 2009).

The National Board for Technical Education (NBTE) and instructors in this sector should lead a movement to boost vocational education financing and improve its image in society, as it has in many other cultures. Those part of the world should immediately start implementing policies aimed at repositioning technical education inside the expanding global economy in order to compete effectively. Reviving this industry is one of the measures to enhance young economic opportunities, according to the United Nations Educational, Scientific, and Cultural Organization (UNESCO). The Nigeria Labour Congress (NLC) and its associated unions may also be able to assist in this regard by building functioning vocational training centres in local government cities where people may acquire new skills (Ojimba, D.P, 2012)**.**

By administering commercial and technical tests, the Royal Society of Arts (RSA) and the City and Guilds of London Institute (CGLI) in some part of the world-controlled craft-level technical education. These committees continued to supervise the study of technical fields even after the establishment of WAEC (West African Examinations Council) in 1952. In 1960, WAEC began acting as an agency for these organizations. Due to foreign restriction of what was taught at technical colleges, curricula were not designed to meet specific national development needs. In addition, trainees received little or no general education to supplement their chosen trades. WAEC took over the administration of examinations in various technical and commercial subjects from RSA and CGLI in December 1972. The federal government decided to augment the CGLI with a technical college-issued certificate known as national Craft Certificate as part of this framework (FCC). The Federal Craft Certificate took into account the practical aspects of the crafts assessed by CGLI. Practical sessions were included to the assessments after WAEC took control in 1978. Despite this, the technical college curriculum for such trades did not contain additional general education. As a result, graduates of these institutes were unable to secure admission to universities. As a consequence, technical education's credibility as both a programme for students with academic difficulties has remained tarnished.

The national policy on education

The 1996 National Curriculum Conference, that brought together a diverse group of Nigerians, highlighted the necessity for a national education strategy. The meeting was called in response to widespread dissatisfaction with the incumbent education systems, which had grown isolated from national needs, aims, and ambitions. During the National Curriculum Gathering in 1973, a conference of specialists from various part of the world interest groups was convened. The conference, which included members from non-governmental groups and foreign organizations, examined what a national school strategy for just a self-governing in some part of the world should seem like. Because education is the most essential tool of charge, this will serve as a crucial priority in national priorities. Any significant alteration in the intellectual environment will be recognized in education. The goal of the policy's far-reaching initiatives, according to the administration, was to revolutionize all elements of the nation's time. To do this, the government formed a National Education Implementation Committee that transform the policy into actionable plans for the agencies responsible for implementing it. The Group was also entrusted with devising an instructional strategy for the monitoring as it developed. The government's education strategy is the government's method to realizing predicted impairments one after another, among each person's potential; that portion of the aims that can be achieved via education. No education strategy, on the other hand, can be formed without first identifying the country's overall philosophy and aims. The administration understands the importance of language in fostering social cohesion, national unity, and cultural preservation. As a result, every baby is forced to learn the language over his or her immediate surroundings. Furthermore, for the sake of national unity, every kid should be required to learn one of the 3 world languages: English, Arabic, or French.

Encourage the training of a sufficient pool of qualified or before schoolteachers, contribute to the development of regular learning, supervise and control the quality of such institutions, and establish pre-primary sections in existing public schools are all government pre-primary education responsibilities. Six years of basic school and three years of junior secondary school will make up basic education. It would be both optional and free. Adult and non-formal education systems for adults and out-of-school children will be offered at the primary and junior secondary levels. At this article, primary education refers to the education delivered in institutions to children aged 6 to 11 years old. The primary level is crucial to the system's successes or failures since it forms the foundation for the rest of the educational system. The time frame will be six years. After finishing elementary school, but before beginning university education, children undergo secondary education. The junior secondary school will offer combined pre-vocational and academic instruction. Tuition will be provided free of charge, to all students, and will be required. It will cover key topics that will allow students to expand their knowledge and skills. The senior secondary school must be comprehensive, with such a core curriculum aimed at broadening pupils' knowledge and perspectives. Forms of functional education delivered to

adolescents and adults outside of the conventional school system, like functional literacy and vocational education, are promoted through mass literacy, adult, and non-formal education. The teaching and learning of scientific processes and principles should be emphasized in science education. This will lead to basic and applied science research at all levels of schooling. After secondary school, tertiary education is provided through universities, colleges of education, and polytechnics.
Distance education should encompass all forms of contact, no contact, and part-time education.
Open/Distance Education is a teaching method in which students are separated from the teacher in both time and space. Special education is a structured special education programme that trains people with special needs (including children and adults). To provide appropriate education for all people with special needs so that they can contribute their fair share to the nation's growth. The implementation of educational policy, as well as the implementation of educational policy, is made easier by the education service. Planning, efficient administration, and enough financial resources are critical to the success of any educational system. Administration is a function of organization and strategic leadership, as well as control, inspection, and monitoring. Education is a costly social service that necessitates adequate financial support from all levels of government to ensure that educational programmes are implemented successfully. The goal of the government is to make education free at all levels. The federal, state, and municipal governments, as well as the private sector, share responsibility for education funding. In this regard, the government invites and encourages engagement from local communities, people, and other groups (Katz, 1999; Duderstadt, 2000).

The impact of introductory technology

Technological improvements might have an impact on how the research institution fulfils its social mission. Inside an increasingly global society connected together with technology, without a single cultural context to provide a "filter," the function of traditional discipline canons is altering.
The quantity and quality of beginning technology teachers appears to be terribly inadequate, according to evidence. Despite a serious insufficient resources while teaching the subject, it is equally important to establish the extent of the issues that prohibit students from achieving well in introduction technology in some part of the world and other locations. Unfortunately, resources for teaching this important matter in our schools are woefully inadequate, especially in some part of the world, where several buildings to accommodate the tools / machines need not to exist, some have structures, equipment, and machineries but no power generation or workshop, making it hard to install the appliances / machines. Students who have finished Introductory Technology in junior secondary school seldom display fundamental technical talents, and as a result, they are unable to overcome the majority of the barriers they face in the labour market. A lack of tool understanding and insufficient workshop arrangements, a shortage of skills teacher, poor monitoring and counselling, and a broad curriculum are some of the problems that students face in Introduction Technology now at Junior Secondary School Level.
The purpose of this study is to investigate the factors that impact students' achievement in introductory technology in some part of the world junior secondary schools.

i. Identify the elements that contribute to students' low performance in Introductory Technology.
ii. Evaluate the state of technical teachers' services.

iii. Address the need for assistance and counselling for students in schools.

iii. Evaluate introductory technology teachers' effectiveness and efficiency.

Introduction technology was an integrated course that encompassed woodworking, metalworking, basic power generation, construction techniques, technical drawing, plastic as well as rubber innovation, and auto/mechanical work. The foundation for the learning of core technical skills and knowledge is laid forth in introductory technology. If students will be unable to complete their studies beyond Junior Secondary School, the skills and knowledge gained at this level would enable individuals to be self-sufficient. The curriculum that must be created should encourage these kids to find, select, and create items using local resources. They should be taught the fundamentals so that they can develop the abilities required for the country's technological development.
Considering this, I recall reading in the media about the federal government's plan to establish a machine tools industry in the country to provide a means of obtaining spare parts for machines and industries, thereby reducing the need for importation, and preserving our limited foreign exchange earnings. In the long run, it is hoped that it would work in tandem with the Ajakuta steel complex in Nigeria for example. This effort was made possible by the establishment of research institutions such as the Nigerian Stored Products Research Institute (NSPRI) in Kano, which developed a new way of preserving fruits and vegetables, The cocoa research institute of Nigeria (CRIN) in Ibadan, the forest research institute of Nigeria (FRIN) in Ibadan, the federal institute of industrial research of Nigeria (FIIR) in Lagos, and the project research organization development agency (PRODA) in Enugu, which are developing prototypes of machines such as corn-thrashers, palm oil extracting machines, yam peelers, and baking machines, will form the foundation of our self-reliance and effective use of our local resources. It may be of interest to members to know that Professor R-rovon, the federal minister of science and technology, recently

authorized two of these research bodies (PRODA) and (FIIR) to build a prototype Nigerian car to minimize high car prices and reliance on imported components (NN 5/2/87).

There is no single country in West Africa that has as many vehicles assembly plants, radio and television assembly plants, oil mills, cement and brick factories, and a host of others that continue to import all spare parts for their machinery as well as raw materials from outside the country as Nigeria. The envisaged machine tool industry and technical research institutes' involvement in Nigeria's future industrial growth is so critical and strategic.

This is like the proposal by the Nigerian Council of Heads of Technology Institutions (COHEADS) to hold a national exposition on technological education. This exhibition aims to showcase the achievements of our polytechnics, universities, and colleges to all Nigerians.

For this purpose, the country is divided into four zones, each with a sub-committee charged with inspecting and approving exhibits to be displayed from member institutions. I am a member of Zone A, which includes all polytechnics in Kaduna, Sokoto, Niger, and Kwara states.

One can question how far our polytechnics and universities have progressed in using local resources to produce and minimize importation equipment and machinery in educational, agricultural, housing, and environmental, arts and textile design, machine tools, mining, and metallurgical fields. We had inspected projects such as chemical manufacture utilizing local millet maize, floor tile production using local clay, and solar energy equipment production (solar distillatory, baking, oven etc.). There are polytechnics that can make corn thrashing machines out of scrap metal. Once started, the machine has an entrance through which corn is introduced, and after passing through the system, it separates the corn from the stalk at various locations for collecting. Another polytechnic (IMT Enugu) has developed a machine that can turn waste papers into ceiling boards and other products.

Conclusion and recommendation

Finally, technicians all who attend technical colleges should be properly and adequately paid. The distinction among holders of 'Basic Studies' credentials and technical certifications in the public sector must be abolished not just as a policy matter, but also in the minds and attitudes of government personnel. Technicians are not seen as second-class citizens. It's a question of choice, so we should start teaching our kids about it in elementary school. Some part of the world's educational system is in desperate need of reform. The study's findings will inform government policymakers, educational authorities, and classroom teachers, as well as industry and society at large, about the problem of pupils' low performance in technology introduction in junior high school that, if not fully addressed, can quash the nation's technological progress.

The outcomes of the study will help technical teachers modify and fix their faults, as well as improve on their prior efforts in order to do better. I believe the government should do everything necessary to abolish the distinction between universities with technical institutes as soon as feasible. Polytechnic colleges should be able to offer degrees. Not only will this attract more undergraduate persons towards vocational/technical education, but will also motivate qualified lecturers/instructors to switch between the two systems. To enhance cross-fertilization of thoughts and technology transfer, our technical institutes must establish favourable contacts and linkages with similar institutions abroad. By doing so, technical institutions will have access to new developments, exchange programmes, and other benefits that are available at universities with well-developed technical programmes. Once technical institutions with industries collaborate, the parties are able to recognize and respect each other's needs, allowing them to deliver the finest solutions for society's benefit.

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RESEARCH ARTICLE

The Characterization of Nanomaterias Using Scanning Electron Microscopy and Environmental Applications

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Abstract

Nano materials are classes of substances that have structural components smaller than 100nm and this includes nanoparticles with at least 2-D between 1 and 100nm in the Nano scale. Nano materials have small size which having at least 1-D 100nm or less. It can be Nano scale in 1-D, 2-D, or 3-D and exist in single, fused, aggregated forms with spherical, tubular and irregular shape. The samples of Nano materials were analyzed with scanning electron microscopy to provide images of Nano particles and their agglomerates in sufficient resolution that gives images of Nano materials with clearly identifiable particles. Nano materials have significant commercial impacts that can be increased in the future. Nano materials have good potential for developing the ways in which materials are generated that, the range and nature of functionalities can be accessed. Applications of Nano materials in the environment are different from one another depending on the type of devices used such as nanotechnologies in coatings for exterior surfaces, solar cells for renewable energy and de-colorization of dyes by the effect of Nano composites, medicine, textile, household, construction, chemical, automotive, electronics and engineering industries.

Keyword: Characterization; Nano materials; scanning electron microscopy; applications

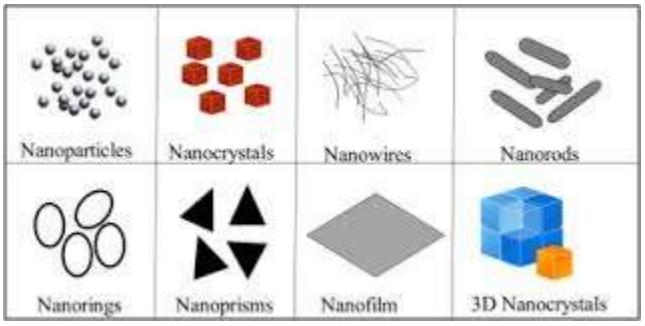
Introduction

Nano materials depend on a range of 1 to 100nm and it is a new field, it is one billionth of a meter (10^{-9}) precisely. Nano materials have high potential applications in many fields. The pressing challenges nowadays is to look for alternative energy sources which can be used comfortably in the environment that depends on the use of Nano materials in different applications like applications in the field of green chemistry and solar cell (6). The properties that Nano materials have due to their small size, are reasons for their numerous applications (15). Nano material has different application in the environment that depends on the type of device used like nanotechnologies in coating for building exterior surfaces, sonochemical decoration of dyes by the effect of Nano composites and solar cells for clean energy (1). Nano materials from natural inorganic occur through crystal growth from chemical reaction in the Earth's crust and the natural sources of nanoparticles occur from volcanic ash, forest fires, radioactive decay of radon gas. According to (11) nanoparticles have three dimensions on the Nano scale and embedded in a bulk solid to form a Nano composite. Nano materials are grouped into nanoparticle and nanostructured materials. The nanostructured refer to as a condensed bulk materials that are made of grains with grain sizes in nanometer size range (17). Today, nanoparticle generate interest from industries and manufacturers, this then leads to new applications in different fields like medicine, electronics, agriculture and host of others. (8) established three groups of nanoparticle as accident Nano materials which appears as product from industrial or natural processes, such as combustions, cigarettes smokes, fires, and artificial Nano materials which are designed by humans with determined properties and characteristics like Ag nanoparticles in shampoos (9), and virus in living beings. The application of nanoparticle enhanced abilities to remove a variety of both pollutants and mineralization of pollutants and also the design, synthesis, modification of novel nanoparticles allow for enhanced performance for environmental related applications (3). Nano material is slowly gaining interest and becoming commercialized (Eldridge, 2014) and emerge as commodities (12). Materials with Nano scale structure always possess unique optical, electronics, thermo- physical and mechanical properties (14), (7).

Characterization of Nano Materials

The International system (SI) unit term nano as a prefix that shows 10^{-9} part of a unit. Nano materials refers to materials with a dimension between 1 and 100nm, the

nanoparticles contain three dimensions in the nanometer range. Quantum mechanical effects can dominate material properties and notable effects can also happened in materials when structures are formed with sizes comparable to any one of many possible length scales. The optical properties of nanoparticles is also a function of the particle diameter, and this effect is shown clearly when the nanometer scale is reached (Wikipedia). When nanoparticles are added to a bulk material, it can strongly influence the mechanical properties of the material like stiffness and elasticity. The polymers can be added to nanoparticles as carbon nanotubes resulting to materials that can be used as light weight replacements for metals. The resulting materials will cause a weight reduction, increase in stability and improved functionality (13). Both the physical and chemical properties of bulk or Nano scale actually depend on its surface properties, but the volume of bulk materials remain unchanged when subdivided into an ensemble of individual Nano materials and the collective surface area is increased (4). According to (16), melting temperature of Nano materials were based on the number of surface atoms and increases of surface to volume ratio which lead to a decrease in particle size and melting point as a result of surface atoms that have greater effect on the chemical and physical properties of nanoparticle. The nature of all materials in bulk has different properties that depends on their structural properties, mechanical, electrical and optical properties like metals, semiconductor and insulators, while nanoparticles have properties that are different from small molecules (1). The physical properties of Nano material are very different from bulk materials which leads to different of new application (5). The electrical properties of nanoparticle material is affected by the microstructure, that is the electrical conductivity which has the value that appears by grain boundary contribution that depends on dc voltages. The grain boundaries in Nano material have great influence on the flow of electronic current. By considering the optical properties of Nano materials, as light incidents on the material from one medium into another, some of the light radiation will be transmitted through the medium and some will be absorbed, some will be reflected at the interface between the two media.



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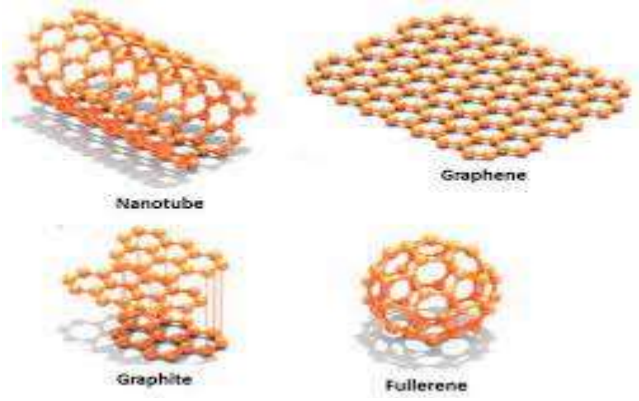

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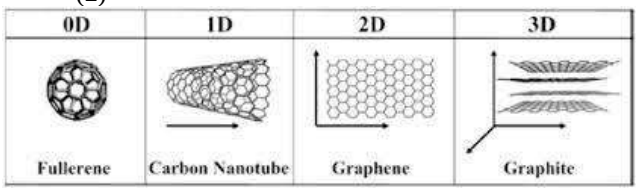

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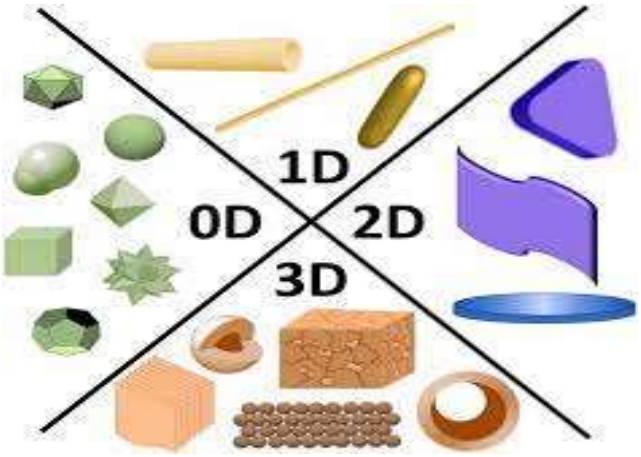

(4)

Figure 3: Pictures 0D, 1D, 2D and 3D Nano materials.

Characterization of Nanoparticles by scanning electron microscopy (SEM)

According to(10) in Ali Salman (2014), scanning electron microscopy (SEM) is an electron microscope that creates images for the sample surface by scanning it with a high energy stream of electrons. In this study, SEM was used to characterize the Nano material (T_i0_2) to reveal information about the surface morphology, the actual composition and sizes of the tested material. The sample was dried, powdered, and then mounted on a sample holder, coating a gold on the surface of the sample. Then, the surface sample is scanned when a high energy stream of electrons is incident on it (9) and the magnified images of less than 3nm in size were produced. But when narrow electron beam was used this gives 3-D characteristics which shows

the sample structure. After one image is obtained at the magnification of 50x, the sample is moved one field of view on the x-axis, and the next image is obtained, then at magnifications of 60x, 100x, 200x and 250x, all these produced different images of the sample. The sample position was slightly adjusted to cover particles completely. The sample was also moved in both x and y direction in order to show the zero- point for the coordinate system of the sample. It was found that using this device, the information collected only limited to distribution size, and average population of nanoparticles, that is the composition of the material.

Power	Total Magnifications
5x	50x
6x	60x
10x	100x
20x	200x
25x	250x

Figure 1: The eyepiece and objective lens, and total magnifications.

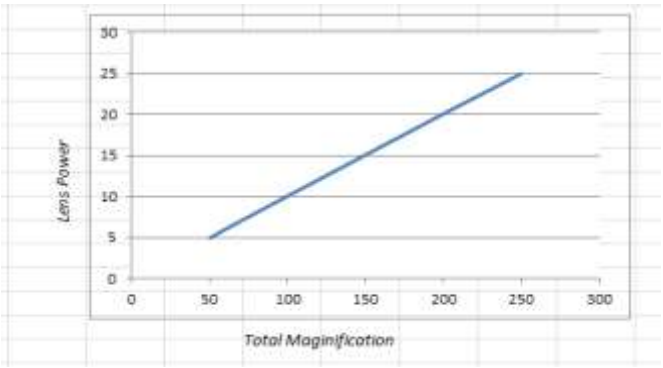

Figure 2: Lens power versus Total magnification.

The eyepiece and objective lens produce power of 5x, 6x, 10x, 20x and 25x that gives total magnifications of 50x, 60x, 100x, 200x and 250x. This means that the images of the particles would appear 50, 60, 100 and 250 times larger than it actually are. From figure 1 and 2. It shows that 5x, 6x and 10x were low power objectives with lower magnification while 20x and 25x are high power objectives with higher magnification.

Environmental Applications

The rapid development in materials and catalysis science and speedy development in technology has led to advances in knowing the usefulness and understanding the controlled synthesis and structure- activity relationship of the Nano materials. The design, synthesis, modification of novel Nano materials allow for enhanced performance for environmental applications (3). The unique properties that Nano materials exhibit due to their small size are strongly responsible for their numerous applications. The 1-D thin film or surfaces of 2-D are very useful in the applications of electronics, chemistry and engineering as thin films at the range of sizes (1-100nm) or monolayer in solar cell or catalysis, these are introduced in different technological applications to include development of sensing system, chemical and biological sensors, fiber- optic systems, magnetic- optic and optical devices (1). T_iO_2 nanoparticles function in solar cell as electrons acceptor. Nano materials are used for data memory, laser diodes, glass fibers, optical switches, filters, conducive and antistatic coatings in the electronic industry. They are also useful for construction materials, flame retardants, building materials for wood, floors, stone, tiles, thermal insulation and other construction materials. Nano materials are very important and useful in both chemical and engineering industries as filters for paint and coating systems which based on Nano composites, magnetic fluids and switchable, adhesives. Also good for wear protection for tools and machines and lubricant- free bearings. Nano materials are also useful in automotive industry for lightweight construction, painting, sensors, coatings for wind screen and car bodies. So many other applications of Nano materials in the environment like in medicine, used for drug delivery system, active agents, medical rapid test, antimicrobial agents and coatings, agents in cancer therapy. In textile, Nano materials are used for surface- processed texiles. Nano materials are very useful in household as storage life sensors, additives, ceramic coating for iron, odors, catalyst, cleaner for glass, ceramic, floor and windows.

Conclusion

Nano materials have numerous applications due to its chemical, physical, mechanical and other properties. It has tunable chemical, physical and mechanical properties due to fine grain size of 1-100nm. It is obvious that nanotechnology has improved and change vision, expectations and capabilities of people to control the world in the field of construction materials. As a result of different production techniques for nanoparticles, no evident with regard to risks associated to potential particle release and if happened at all, the risk of particle release during production process is very low (9). The exposure to nanoparticle could only happen after manufacturing process.

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