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ARTICLES AND RESEARCH REPORTS ON SCIENCE

INVESTIGATION INTO THE USE OF VEGETABLE (PEANUT) OIL AS A POSSIBLE ALTERNATIVE TO HYDRAULIC BRAKE FLUID

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Abstract
There is a growing concern over the problem of biodegrability of hydraulic fluid especially when spilled or disposed and its non-renewable source. This research is aimed at investigating the use of peanut oil as an alternative to hydraulic brake fluid. In this research, nine samples with different proportions of hydraulic brake fluid and peanut oil were analyzed to determine the following properties; viscosity, kinematic viscosity, boiling point, density, specific gravity, flash point and fire point. The result of this analysis shows that the properties of unblended or blended peanut oil with hydraulic brake fluid conform to the required specification. Therefore, it is concluded that unblended or blended peanut oil with hydraulic brake fluid could be used as hydraulic brake fluid. The use of peanut oil could be said to have advantage over conventional hydraulic fluid because of its biodegradability in the environment and renewable source, while the blend of hydraulic brake fluid with peanut oil may improve the biodegradability of the mixture.

Introduction
Vegetable oil lubricants are emerging as an environmentally preferable alternative to established petroleum products. Vegetable oil can offer even better performance in some applications, with added benefits of being less toxic, renewable and biodegradable. Vegetable based oil pose greatly reduced threat to human health and the environment (King, 2001; Miller, 2012; Berth, 2008).

While the use of vegetable oil may be somewhat surprising at first, when examined in an historical context we can see that the compression engine first developed to a usable level of functionality by the French born Rudolf Diesel near the end of the 19th century was originally designed to work on vegetable oil. In 1900, Rudolf Diesel demonstrated his new compression ignition engine at the world exhibition in Paris running on peanut oil. In 1911 he wrote “the engine can be fed with vegetable oil and would help considerably in the development of agriculture in the countries that use it”. It was about this time that new drilling technology and exploration were developed and together this ushered in the age of cheap and plentiful fuels (Biodiesel, 2011).

Peanut oil is obtained from peanut crop. The seed of the peanut contains 40-45% oil. Peanut has traditionally being used as a source of oil (Singh, 1991). Its major component fatty acids are oleic acid (46.8% as olein), linoleic acid (33.4% as linolein), and palmitic acid (10.0% as palmitin) (Nutrient, 2011). Extraction of oil from peanut seed is done by pressing and then solvent extraction. The peanut oil extracted is not pure as it definitely contains unwanted minor which must be removed for better quality performance. Refining is a process of removal of unwanted components in oil (Macrae *et al*, 1997).

Hydraulic power is one of the engineers’ most versatile tools for ensuring that adequate force is provided in places where more conventional power transmissions would have found the task difficult or impossible. Today hydraulic power is found in countless applications ranging from the operation of automobile brakes to the raising and lowering of control surfaces, flaps and landing gear on board

aircraft (David, 2000; Philips, 2000). Hydraulic fluid is utilized in large quantities in a variety of applications and is susceptible to spillage. When spilled, they pose an immediate threat to the surrounding environment. Spilled oil can contaminate streams, kill vegetation and harm wide life and remediation is costly (King, 2001).

Consequently hydraulic industries have being working hard to develop new types of highly biodegradable and environmentally friendly fluid which can still do their jobs of transmitting power as efficiently as ever, but without the unwanted result of contamination caused by even the smallest accidental spillage (David, 2000).

Materials and Method

The samples used in this experiment are refined peanut oil and (conventional) hydraulic brake fluid. The refined peanut oil was obtained from Golden Nut Oil industry (a peanut oil processing industry) in Minna, while the hydraulic brake fluid was obtained from market outlet in Minna.

Sample Preparation

The hydraulic brake fluid and peanut oil collected were represented as x and y respectively. Nine samples represented as A, B, C, D, E, F, G, H and I were prepared (blended) with different proportions of x and y as follows:

Sample	Composition %		Volume (cm^3)	
	x	y	x	y
A	100	0	300	0
B	87.5	12.5	262.5	47.5
C	75.0	25.0	225.0	75.0
D	62.5	37.5	187.5	112.5
E	50.0	50.0	150.0	150.0
F	37.5	62.5	112.5	187.5
G	25.0	75.0	75.0	225.0
H	12.0	87.5	37.5	262.5
I	0	100	0	300

Determination of Viscosity

Procedure

The viscometer was charged with the sample and the suction was applied through the thicker arm. The sample was drawn up to the upper timing mark of the inverted viscometer. The thinner arm was wiped and the instrument turned to its normal vertical position. The viscometer was then placed into a holder and inserted into a constant temperature bath at 40℃ and 100℃ at which the sample viscosity was determined.

The sample was placed in the bath for about 10 minutes to come to the bath temperature at 40℃ and 15 minutes at 100℃ respectively. Suction was then applied to the thinner arm and the oil drawn slightly above the upper turning mark and the efflux time was obtained by timing the flow of the sample as it flows freely from the upper timing mark to the lower timing mark.

The kinematic viscosity was calculated by multiplying the efflux time in second by the viscometer constant (0.014).

Determination of Flash Point and Fire Point

Procedure

A test tube was filled to a specific level with the sample to be tested. The burner was set on to heat the sample rapidly initially and slowly as the flash point is approached. At 200℃ a small swivel test flame application was passed across the centre of the test tube with a smooth continuous motion. At a point, the vapour above the surface of the sample ignited the test flame applicator and the temperature at this point was noted and recorded as the flash point.

The test was continued and at a certain temperature the flame caused the fluid sample to ignite and burnt continuously for about 5 seconds. The temperature at which this occurred was noted as the fire point.

Determination of Density and Specific Gravity

Procedure

A 50cm^3-measuring cylinder was weighed while empty. Then a given 50cm^3 of the sample was poured into the measuring cylinder and weighed. The difference between the weight of the empty measuring cylinder and weight of the cylinder with 50cm^3 of sample was found. The difference which is the weight of the sample was then divided by the volume.

Therefore density =

$$\frac{\text{Wt (g) of measuring cylinder with sample – wt (g) of empty cylinder}}{\text{Volume of sample}}$$

For the specific gravity, the same procedure above was applied for water at equal volume by subtracting the weight of the measuring cylinder with water from the weight of the empty cylinder to obtain the weight of pure water at the same temperature.

Therefore, specific gravity (S.G) =

$$\frac{\text{Weight of a given volume of sample}}{\text{Weight of equal volume of pure water at the same temperature}}$$

Determination of Boiling Point

Procedure

The sample was heated on heating mantle with a thermometer inserted in the sample until bubbles started to form, the temperature was noted and observed for any possible change when vapour starts to form. The temperature was recorded as the boiling point of the sample.

Results

The results obtained are presented in the Tables below:

Table 2: Efflux time of samples

Sample	Eflux time (sec)	
	40^{o}C	100^{o}C
A	75	55
B	94	58
C	113	61

D	123	83
E	140	105
F	152	115
G	163	125
H	180	149
I	189	172

Table 3: Kinematic viscosity, density and specific gravity of samples

Sample	KV(40) cm^2/s	KV(100) cm^2/s	Density g/cm^3	Specific Gravity
A	1.05	0.77	1.0142	1.025
B	1.32	0.81	1.0076	1.0194
C	1.58	0.85	1.0008	1.0136
D	1.78	1.16	0.9912	1.0055
E	1.96	1.47	0.9816	0.997
F	2.13	1.61	0.9476	0.963
G	2.28	1.75	0.9134	0.9392
H	2.52	2.09	0.9056	0.9326
I	2.65	2.41	0.8978	0.926

Table 4: Viscosity, boiling point, flash point and fire point of samples

Sample	V(40) g/cm sec	V(100) g/cm sec	Flash point (^oC)	Fire point (^oC)	Boiling point (^oC)
A	1.065	0.781	202	211	161
B	1.326	0.818	207	219	162
C	1.583	0.008	209	221	164
D	1.762	1.154	214	222	165
E	1.924	1.443	219	226	165
F	2.015	1.526	220	230	170
G	2.084	1.600	221	237	173
H	2.282	1.880	226	238	173
I	2.476	2.160	228	241	175

Discussion of Results

Table 3 shows that kinematic viscosity was increasing as the proportion of the peanut oil increases in the blend. It is also observed that the kinematic viscosity of unblended peanut oil (2.758 at 40℃ and 2.408 at 100℃) is greater than that of the unblended hydraulic brake fluid (1.05 at 40℃ and 0.77 at 100℃).

Also on the same Table, the density is observed to be decreasing as the proportion of the peanut oil increases. This implies that unblended peanut oil (density of 0.8975) is less dense than unblended hydraulic brake fluid (density of 1.0142), however density of all the samples conforms to the specification of 0.85 to 1.057(Sunoco, 2001).

Table 4 shows that at 40℃, the viscosity was increasing as the proportion of peanut oil increases in the blend. The viscosity of the samples (A, B, C, D, E, F, G, and H), are observed to conform to the specification of 1.05 - 2.35 (Sunoco, 2001), except that of the sample I, but the variation is very small and can therefore be considered negligible. On the same table, at 100℃ the viscosities of the

sample are observed to be increasing as the proportion of peanut oil increases in the blend. Viscosity of all the samples are observed to conform to specification of 0.8 - 2.25 (Sunoco, 2001).

The flash point and fire point of all samples on Table 4, are observed to be within the acceptable limit, that is all conform with the specifications of 190-330℃ and 205-250℃ for flash and fire point respectively. On the same table, boiling point of all samples are observed to also conform to the specification of 155-270^{o}C (Sunoco, 2001).

Conclusion

It is therefore concluded that unblended peanut oil or a blend of peanut oil and conventional hydraulic brake fluid could be used as a possible alternative to hydraulic brake fluid. The use of peanut oil could be said to have advantage over conventional hydraulic fluid because of its biodegradability in the environment and renewable source, while the blend of hydraulic brake fluid with peanut oil may improve the biodegradability of the mixture.

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INFLUENCE OF DYE EXHAUSTION ON THE DYEING OF COTTON AND VISCOSE RAYON WOVEN FABRICS WITH DIRECT DYE

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Abstract
Before dyeing the two fabrics, preparatory processes was carried out for the two fabrics. These involve desizing, scouring and bleaching. The two fabrics were dyed at the same temperature, time, and concentration. The dyeing temperature was at 75ºC and at a concentration of 1% of the dye (direct dye) for 15mins. Calorimeter was used to measure the rate of dye exhaustion. At the end of the experiment, it was found that cotton fabric absorbed more dye than the viscose rayon fabric.

Keywords: Preparatory processes, Direct dye, Exhaustion, Properties

Introduction

Dyeing is one of the most ancient crafts and its history can be traced back at least 4000 years ago. It involved a high degree of skills and details of the methods used by dyers were jealously guarded because, it was considered a secret technology (Isah, 2009; Bird and Boston, 1976). A dye is defined as any substance which is deeply coloured soluble in water, and can impact the colour to it substrate when dissolved in water, or could be defined as an organic chemical of chiefly synthetic origin although some are also extracted from plant, most dyes were synthesized from raw materials (chemicals) derived from coal tar or petroleum (Gin et al, 2012; Giles, 1974; Nuhu, 1979; Vencataraman, 1972). Until the middle of the 19^{th} century, all dyes used were natural products, extracted in most cases from a variety of plants, but also from a few animal sources (Isah, 2009). Direct dyes were introduced in 1884 by Bottiger. Electrolyte were used to promote dye exhaustion and such dyes colour cotton and its derivatives directly (Abah, 2006; Meng and Jiliang, 2010). Direct dyes are anionic dyes substantive to cellulose when applied from an aqueous bath containing an electrolyte. They provide the simplest means of dyeing cellulose materials since they are normally applied from a neutral or slightly alkaline bath, near the boil, to which these electrolytes are added. Based on their application to cellulose, direct dyes give a wide range of shades and poor to moderate washing and light fastness properties (Abah, 2006; Nkeonye, 1994). Direct dyes provide the simplest means of dyeing cellulose materials. They are generally applied from a metal or slightly alkaline bath at or near the boil to which electrolyte could be added in small quantities and at such interval of times appropriate to the dyeing proper of individual dyes (Abah, 2006; Sani, 2010; Trotman, 1970). The purpose of this research is to dye cotton and viscose rayon fabrics and compare the rate of dye exhaustion of these fabrics using the optical densities obtained from UV spectroscopy machine.

Materials

The materials used includes grey cotton and viscose rayon fabrics, biolase (enzyme), sodium silicates ($NaSi0_3$), sodium hydroxide (NaOH), hydrogen peroxide (H_2O_2), sodium chloride (NaCl), sodium carbonate (Na_2CO_3), durazol orange 4R (direct dye)

Methods

Preparatory processes

Each of the fabric was weighed to 1.5g and a Liquor ratio of 100:1 was maintained throughout the preparatory processes.

Desizing

The fabrics were impregnated with 2% solution of enzyme biolase for 20 minutes at room temperature. The samples were removed and then rinsed in 2.5% NaOH solution at about 90^0C. Then, this was followed by rinsing in water at 90^0C. It was finally rinsed in cold water and dried. To test for the efficiency of the treatment, two drops of iodine was applied to the treated fabric and the untreated fabric. The sized piece turned blue black indicating the presence of starch while the desized piece retained the yellowish colour of iodine showing that starch has been removed during the desizing process.

Scouring

The samples were treated with 2% NaOH solution for 10min at the boil. The samples were removed and rinsed thoroughly with water and dried. The efficiency of scouring was tested by padding the desized and scoured fabric in water. It was found that the scoured got wet after 30-35 seconds while the desized took longer time to get wet.

Bleaching

The bleaching was done in a bath containing hydrogen peroxide bleaching agent, 3 to 5% o.w.f H_2O_2 (30%), 0.6 to 1.4% caustic soda and 2 to 3% o.w.f sodium silicate (79%), the bleaching was about 40-60mins at the boil. The samples were then removed properly rinsed and then dried.

Dyeing with Durazol orange 4R (direct dye)

Preparation of the dye bath: the weight of each fabric is 1.3g and the liquor ratio of 30:1 was used throughout the dyeing.

The dye bath contains:

1% of Durazol orange dye,

2.5% Percentage shade,

20% (5.85g) of salt concentration

Dyeing of viscose rayon and cotton woven fabrics with direct dye

The rate of exhaustion of viscose and cotton fabrics with direct dye were studied empirically with the help of calorimeter. The λ_{max} of the dye used is 505nm. The dyeing was carried out at 75ºC for 15mins at a constant concentration of 1% of dye used. The spectrophotometer is a highly sophisticated machine used for the determination of the absorbance (optical density) of substances. The machine makes use of a monochromatic light (Meng and Jiliang, 2010). This was used for taking the maximum absorbance of the dye.

Measurement of optical density

The visible spectrophotometer was used to take the wavelength of maximum absorbance of the dye which is 505nm. The optical densities of the dye bath before and after each dyeing were obtained with this instrument. It was ensured that the wavelength was set to the maximum wavelength of the dye used at that point while using the instrument. Distilled water was used as the blank to calibrate the instrument to zero absorbance in each case.

Determination of exhaustion

The spectrophotometer was used in determining the optical densities (absorbances) of the bath before and after dyeing. The machine was set to zero absorbance using distilled water. The exhaustion was calculated as follows:

$$\text{Exhaustion (\%)} = \frac{D_1 - D_2}{D_1} \times 100$$

D_1 = optical density before dyeing

D_2 = optical density after dyeing

$D_1 - D_2$ = amount of dye transferred into the fabric after dyeing.

The Dyeing was carried out at a constant concentration of 1% Durazol orange 4R, temperature of 75^0C and at a time of 15mins.

Results

Table 1: Rate of dye exhaustion of direct dye with cotton fabric

Samples	D_1(a)	D_2(b)	Rate of dye exhaustion (%) (a)	D_2(b)	Rate of dye exhaustion (%) (b)	Average rate of dye exhaustion (%)
1	0.678	0.084	87.61	0.071	88.35	87.98
2	0.678	0.085	87.46	0.084	87.61	87.54
3	0.678	0.037	94.54	0.034	94.77	94.77
4	0.678	0.032	95.28	0.03	95.58	95.43
5	0.678	0.027	96	0.03	95.58	95.79
6	0.678	0.036	94.69	0.034	94.85	94.85
7	0.678	0.047	93.07	0.048	92.92	93
8	0.678	0.034	94.99	0.036	94.69	94.84
9	0.678	0.023	96.61	0.025	96.31	96.46
10	0.678	0.041	93.95	0.042	93.81	93.88

Average rate of dyeing = 93.45%

Table 2: Rate of dye exhaustion of direct dye with viscose rayon fabric

Samples	D_1	D_2(a)	Rate of dye exhaustion (%) (a)	D_2(b)	Rate of dye exhaustion (%) (b)	Average rate of dye exhaustion (%)
1	0.678	0.09	86.73	0.081	86.61	86.67
2	0.678	0.081	88.05	0.105	84.5	86.28
3	0.678	0.075	89.3	0.069	89.82	89.56
4	0.678	0.041	93.95	0.028	95.87	94.91
5	0.678	0.037	94.54	0.041	93.95	94.25
6	0.678	0.058	91.45	0.053	92.18	91.82
7	0.678	0.048	92.92	0.051	92.48	92.7
8	0.678	0.043	93.66	0.04	94.1	93.88
9	0.678	0.032	95.28	0.039	94.25	94.77
10	0.678	0.045	93.36	0.047	93.07	93.22

Average rate of dyeing = 91.81%

Discussion of Results

The exhaustion of direct dye with viscose rayon and cotton fabrics is shown in Tables 1 and 2. The two Tables show how cotton and viscose rayon fabrics absorbed dye at the same time, temperature and concentration of dye. The exhaustion of the dye used was measured before and after dyeing. The reading of the dye exhaustion after dyeing was taken twice and the average rate of dyeing was calculated for both fabrics. The Tables also shows that the rate of exhaustion of cotton with direct dye is higher than the viscose rayon due to the fact that the dye enter the fabric in a molecularly dispersed state and then became aggregated to such a size that they cannot easily migrate out again.

Conclusion

The exhaustion properties of direct dye with viscose rayon and cotton fabrics were different. From the Tables, it shows that cotton absorbed direct dye more excellently than the viscose rayon fabric due to the amorphous nature of cotton fabric. The cotton structure is not orderly arrange and so compacted, so the dye was easily absorbed than the viscose which has a crystalline structure. However, cotton absorbed more direct dye than viscose rayon. For cotton fabric, the average dye exhaustion is 93.45%, while viscose rayon fabric the average dye exhaustion is 91.81% at the same temperature, time and concentration of dye used.

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SPECTRAL DEPTH ANALYSIS OF PARTS OF BORNO BASIN, NIGERIA, USING AEROMAGNETIC DATA

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Abstract
Statistical spectral analysis of the residual magnetic field values was employed in this research to determine the depth to the magnetic basement rocks of parts of Borno Basin. The area of study lies between latitude 12^{0}N to 13 5^{0}N and longitude 12^{0}E to 13 5^{0}E. The first magnetic layer from spectral depth analysis was attributed to lateritic ironstone, ferruginous sandstone and effect of surrounding basement rocks with an average value of 0.283 km. The second layer was attributed to magnetic rocks that intruded onto the basement surface, lateral discontinuities in basement susceptibilities and inter-basement features like faults and fractures. The second layer thus represents the depth to basement in the area and this depth has an average value of 2.99 km. This represents the average thickness of the sedimentary formation overlying the Basement Complex over the area under investigation. The generalized depth to basement map produced reveals that the basin is relatively shallow with a maximum depth (thickness) of 5.34 km at the northeastern part of the study area. This increases the possibility of hydrocarbon accumulation in the area.

Keywords: Spectral depth, magnetic layer, sediments, basement and aeromagnetic data.

Introduction

The study area covers parts of the Borno Basin- Latitude 12^{0}N - 13.5^{0}N and longitude 12^{0}E - 13.5^{0}E, of square block 24,200 km^2, the Schist belt (Kerikeri formation). This area is situated at the north-eastern part of Nigeria, as shown in Figure 1. The Borno Basin (or "Maiduguri Sub-basin" of Avbovbo *et al.,* 1986) makes up the south-western part of the Chad Basin (Figure 1). The Cretaceous sediments in the Borno Basin are almost entirely concealed by the continental Pliocene to Pleistocene Chad Formation (Carter *et al.,* 1963; Barber, 1965; Miller *et al.,* 1968) which reaches a thickness of over 1500 m (Olugbemiro, 1997). Descriptions of the Borno Basin have been given by Raeburn and Jones (1934), Matheis (1976), Avbovbo *et al.* (1986), Okosun (1995a) and Olugbemiro, (1997). Those parts of the Chad Basin to the north and east were reviewed by Bellion (1989) with important subsequent accounts given by Genik (1992, 1993). The latter provided detailed descriptions of the concealed east Niger, Bongor, Doba, Dosco and Salamat rifts. The southern part of the Borno Basin is covered by the Geological Survey of Nigeria 1/250,000 Series map sheets 25 (Potiskum). Raeburn and Jones (1934), Barber (1965) and Miller *et al.* (1968) produced the geological maps of parts of the area to the north.

The present term "Gongola Basin", correspond to the "Chad Basin" of Carter *et al.,* (1963). A series of N-S to NNE-SSW trending faults controls the trend of the Gongola Basin (Zaborski *et al.,* 1998). The thickest sedimentary successions occur in the western part of the Gongola Basin to which Campano-Maastrichtian and Cenozoic deposits are restricted. Over 5km of sediments occur in the "Dukku", "Ako" and "Bashar" sub-basins; thinner successions occur in the "Lau" and "Numan" sub-basins of the Yola arm (Benkhelil, 1988, 1989). The Yola arm extends eastwards into Cameroun where it is known as the Garoua Basin.

Similarly, Cratchley (in Avbovbo *et al.,* 1986) recognized an ovoid-shaped negative Bouguer gravity anomaly north of Maiduguri. Combining the gravity data with seismic refraction studies, Cratchley *et*

al., (1984) identified a "Maiduguri Trough", thought to contain some 3000m of Cretaceous and Quaternary sediments, running NNE from near Maiduguri and connecting with the Termit rift. A positive regional gravity anomaly of about 45 mgal amplitude was associated with the Maiduguri Trough, by comparison with the Benue Trough, this anomaly being interpreted in terms of crustal thinning. Seismic reflection data of Avbovbo *et al.,* (1986) inferred a total thickness of over 10 km of Cretaceous to Quaternary sediments in the "Maiduguri depression". The Chad Formation has been attributed to a thermal sag stage of basin development subsequent to rifting in the WCARS (Fairhead, 1986, 1988a and 1988b; Fairhead and Okereke, 1987, 1990). Sahagian (1993) and Hartley and Allen (1994) believed that uplift of its periphery, notably that of the Hoggar, Air, Tibesti and Darfur domes, was the most important control on Neogene-Recent sedimentation in the Chad basin.

In this study, spectral analysis of the residual magnetic field map of the aeromagnetic data covering part of Borno Basin has been estimated and the upward continuation of the total field map of the study area was analyzed to corroborate the results of the spectral depth analysis.

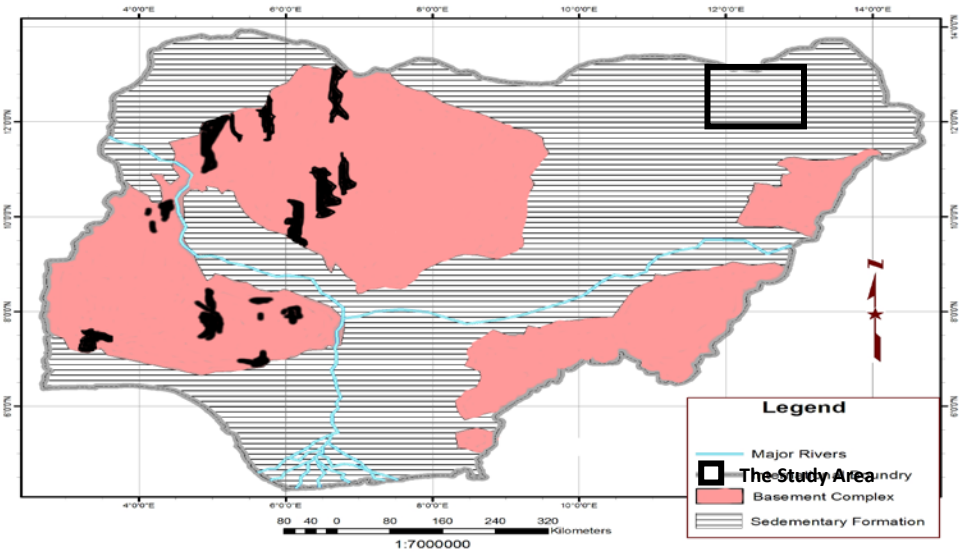


Figure 1: General geology Map of Nigeria Showing the Sedimentary Formation and Location of the Study Area

Data Collection

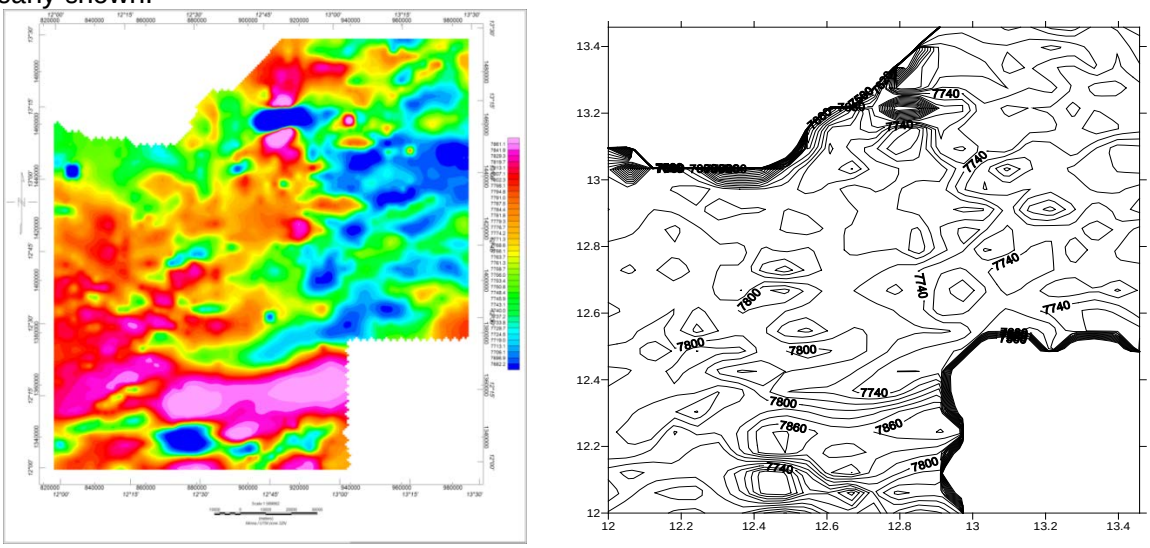
Aeromagnetic survey of a substantial part of Nigeria was carried out by the geological survey of Nigeria between 1974 and 1980. The magnetic information consists of profiles or flight lines plotted on continuous strip chart or tape records. To achieve this, the Nigeria landmass was divided into blocks. The magnetic data were collected at a nominal flight altitude of 152.4 m along N-S flight lines spaced approximately 2 km apart. The aeromagnetic survey measured only the total field, F. The data were later published in the form of $^1/_2{}^o$ by $^1/_2{}^o$ aeromagnetic maps on a scale of 1: 100, 000. The magnetic values were plotted at 10nT (gamma) interval. Eight (8) aeromagnetic maps i.e. maps numbers 22, 23, 24, 43, 44, 45, 65 and 68 were used for the study area. Each map was digitized on a 1.5 x 1.5 km^2 grid system.

After digitizing each aeromagnetic map, the data were collected and recorded in 38 by 38 coding sheets. The values obtained were then re-contoured and the resulting map was compared with the original map. Figure 2 is the method of eliminating edge effect as it was done in this work to obtain the super map.

GAMAZAGI 22	ZARI 23	KARIRIWA 24
BORGO 43	GAZABURE 44	GUDUMBALI 45
CHUNGUL-BULTURI 65	GUBIO 66	

Figure 2: Method of Eliminating Edge Effect in Super Map.

Figure 3 is the Total Magnetic Intensity map of parts of Borno Basin, which was later produced at a lower gridding and contoured at 20nT intervals. This was done so that the contour lines would be clearly shown.

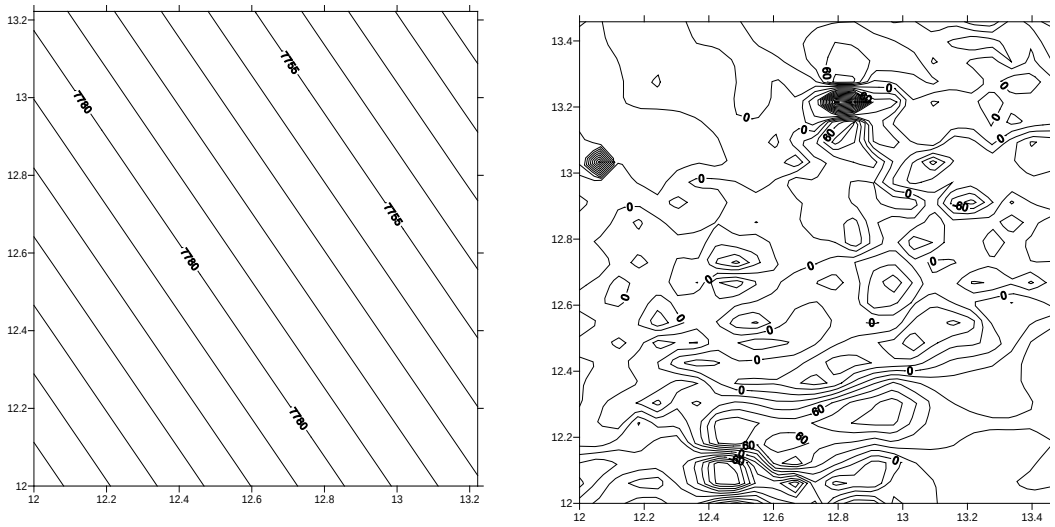


(a) (b

Figure 3: Total Magnetic Intensity Map of the Study Area, (a) Using Oasis Montaj and (b) Using Surfer8 Package. Vertical and Horizontal Axes are in Degrees.

The contour values shown in Figure 3 ranges from 7740nT to 7800nT after the base value of 25,000nT have been removed from all data points. Figure 3 is the Total Magnetic Intensity map of parts of Borno basin. For potential field data to be interpreted, the residual anomalies must be separated from the regional (background) field. The polynomial fitting method is about the most flexible and most applied of the analytical method for determining regional magnetic field (Skeels, 1967; Johnson, 1969 and Dobrin, 1976). In this method, the matching of regional by a polynomial surface of low order exposed the residual features as a random error. The treatment is based on statistical theory. The observed data were used to compute, usually by least squares, the mathematically describable surface giving the closest fit to the magnetic field that can be obtained within a specified degree of detail. It was assumed reasonably that the regional field is a first degree

polynomial surface. All the regional fields were therefore calculated as two dimensional (2-D) first degree polynomial surfaces. A computer program was used to derive the residual magnetic values by subtracting values of the regional fields from the total magnetic values at the grid cross point. **Figure 4: (a) and (b) shows the regional magnetic map and the residual map of the study area respectively**



(a) (b)

Figure 4: (a) Regional Magnetic Map of the Study Area showing the NW-SE trend (b) Residual Magnetic Map of the Study Area (contour intervals is 10nT). Vertical and Horizontal Axes are in Degrees.

Spectral Analysis

Spectral analysis involves a plot of a radially-averaged power spectrum on a natural logarithmic scale. In general, it is found that potential field anomalies analyzed in this way display something approaching a natural power-law spectrum, such that, much energy comes from large, deep sources (at a low wavenumbers) and relatively little (orders of magnitude less) from small, shallow ones (high wavenumbers) with an approximately exponential decay with wavenumber. Beyond the Nyquist wavenumber, the spectrum is meaningless, (any energy originally here will be aliased or folded-back into lower wavenumbers), but usually noise predominates at wavenumbers approaching the Nyquist wavenumber if a sound sampling regime was established for the survey. The research area covering latitude 12^0N - 13.5^0N and longitude 12^0E - 13.5^0E was subdivided into sixteen sections for the purpose of spectral depth determination. A sample of the logarithm of the spectral energies against frequencies obtained for the various sections are shown in Figure 5.

When considering a line that is long enough to include many sources, the log spectrum of this data can be use to determine the depth to the top of a statistical ensemble of sources using the relationship.

$$Log\ E(k) = 4\pi hk$$

where h is the depth in ground – units and k is the wavenumber in cycles / ground _ unit.

The depth of an 'ensemble' of source can be determined by measuring the slope of the energy (power) spectrum and dividing by 4π.

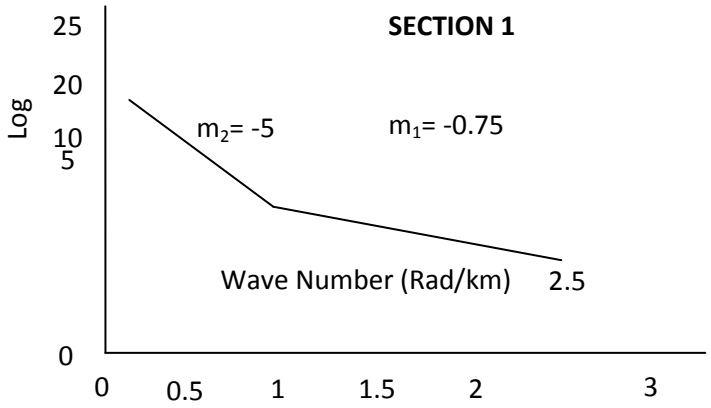


Figure 5: A Sample of the Logarithm of the Spectral Energies against Frequencies

Data Analysis

For this analysis, the study area is divided into sixteen (16) sections allowing spectral depth determination at every 15 km by 15 km interval of the field. These depths were shown as H_1 and H_2 in Table 1.

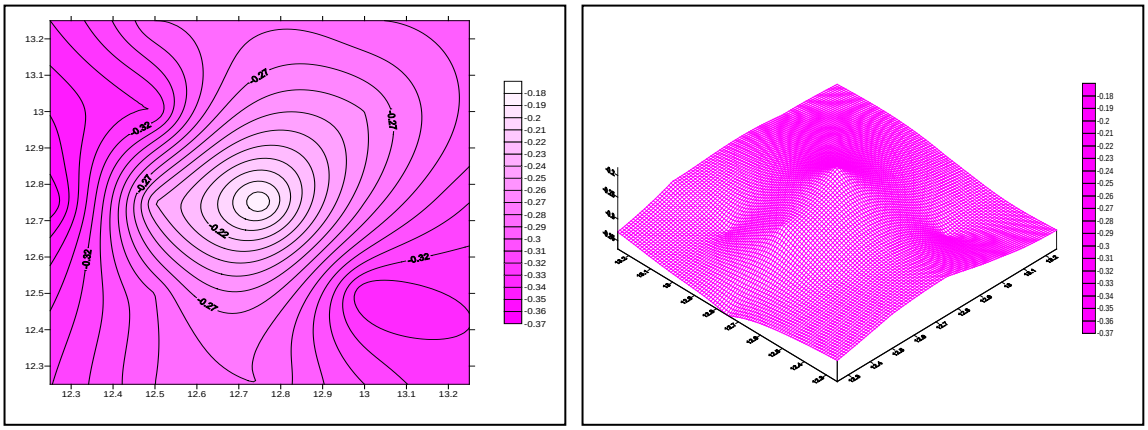
From the table, the first layer depth (H_1) varies in thickness from 0.18 km minimum to 0.37 km maximum, and has an average thickness of 0.283 km. The second layer (H_2) depth varies from a thickness of 1.79 km minimum to 5.34 km maximum and has an average depth of 2.99 km.

Table 1: Depth Estimate: Location for the First and Second Layers

SECTION	LONGITUDE	LATITUDE	H_1 (km)	H_2 (km)
1	12.5	12.5	0.29	2.5
2	12.5	13	0.33	1.79
3	13	12.5	0.34	3.75
4	13	13	0.26	5.34
5	12.75	12.25	0.28	2.82
6	12.75	12.75	0.18	2.43
7	12.75	12.25	0.22	3.75
8	12.25	12.75	0.37	2.5
9	12.75	12.75	0.25	5
10	13.25	12.75	0.31	1.82
11	12.5	12.25	0.29	3.09
12	12.5	12.75	0.24	3.5
13	12.5	13.25	0.29	2.11
14	13	12.25	0.31	2.73
15	13	12.75	0.27	2.5
16	13	13.25	0.29	2.13

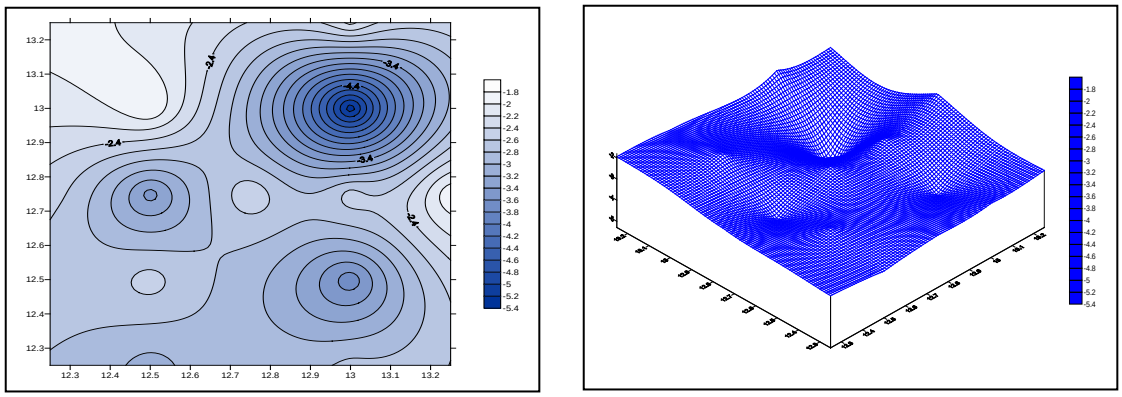
Data Interpretation

Figure 6(a) depicts first layer H_1 depth contoured at an interval of 20 meters vertical and horizontal axes in degrees. The high depth is at the central region which is, area on the map with light pink colour, while the low depths with deep pink colour are at the surrounding edges of North, South and Eastern part of the map. Figure 6(b) depicts the Surface plot of first magnetic layer. Figure 7(a) depicts second layer H_2 depth contoured at an interval of 50 meters vertical and horizontal axes in degrees. The high depths with light blue colour are seen in the North and Southern region, while the low depths with deep blue colour are found at the Eastern and central part of the map. Figure 7(b) depicts the Surface plots of second magnetic layer.



(a) (b)

Figure 6: (a) First Layer H_1 Depth Contoured at an Interval of 20metres (b) Surface Plots of First Magnetic Layer



(a) (b)

Figure 7: (a) Second Layer H_2 Depth Contoured at an Interval of 50metres (b) Surface Plots of Second Magnetic Layer

The most promising region where the depth of 5.34 km could be found lies between latitude$12^0$45' to $13^0$15'N and longitude $13^0$00' to$13^0$30'E of figures 7(a), which corresponds to the northeastern part of Figure 7(a). This area has the sedimentary thickness (or highest depth to basement).

Conclusion

A critical examination of Figure 7(a), Second layer (H_2) depth contour map, shows that the Northeastern of the study area, around Kaririwa, contains the highest accumulation of sediments (5.34 km). This depth could infer the presence of hydrocarbon.

Summary

The spectral depth estimation of the depth to basement on the parts of Borno basin had shown a maximum depth estimate or sedimentary thickness of over 5 km which could be obtain around Kaririwa area of the study area.

Recommendations

The accumulation of sediments in the northeastern part of the Borno basin, could suggests the presence of hydrocarbon. We wish to recommend that bore hole be sunk and the well log be done to confirm further, this findings. However seismic reflection survey could be done around the area found to have a depth estimate of over 5 km.

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INVESTIGATION OF THE EFFECTS OF CASCADING MULTISTAGE JFET COMMON SOURCE AMPLIFIER ON GAIN AND BANDWIDTH

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Abstract
In this work, effects of cascading on a high gain broadband amplifier implemented with Junction Field Effect Transistors (JFET) cascaded in common source amplifier configurations for gain enhancement and bandwidth shrinkage is presented. The transfer characteristics of N-channel BF245A JFET was investigated, so also the drain characteristics up to a drain voltage of 30V, and its mutual characteristics over a gate voltage of 0 to $-1.5V$ *were recorded. A chain of four stage common source amplifier was used to study the effects of cascading on gain and bandwidth of the amplifier. Results from simulations revealed that for a single- stage, the gain was found to be* $24dB$ *while the bandwidth was found to be* $0.59GHz$*. The two-stage cascade has a gain of* $34dB$ *and a bandwidth of* $0.37GHz$ *. The three-stage connection recorded a gain of* $46dB$ *and a bandwidth of* $0.29GHz$ *and finally for a four-stage cascade connection, the gain was obtained as* $54dB$ *while the bandwidth was obtained as* $0.29GHz$*. In general, it was observed that as the number of stages was increased, there was a corresponding increase in the gain at the expense of the bandwidth. Electronics software called multiSIM 8.0 was used in carrying out this research.*

Introduction
The performance obtainable from a single stage amplifier is often insufficient for many applications. In most applications, a single-transistor amplifier will not be able to meet the combined specifications of a given amplification factor, input resistance and output resistance. Hence several stages may be combined to form a multistage amplifier. These stages are connected in cascade, that is, output of the first stage is connected to form input of the second stage, and so on. Cascading is done either to increase the overall small signal voltage gain or provide an overall voltage gain greater than unity, with a very low output resistance [1, 2].

The primary function of an amplifier is to reproduce the applied signal and provide some level of amplification. Unipolar transistors can be used to achieve this function. Junction Field Effect Transistors (JFET) and Metal Oxide Semiconductor Field Effect Transistors (MOSFET) are examples of unipolar amplifying devices. The *common-source amplifier* is the most widely used FET circuit configuration. The input signal is applied to the gate-source and the output signal is taken from the drain-source. The source lead is common to both input and output. A common-source amplifier has a very good ratio between input and output impedance. Circuits of this type are extremely valuable as impedance-matching devices. Common-source amplifiers are used almost exclusively as voltage amplifiers. They respond well in radiofrequency signal applications [3].

The common-source amplifier has infinite input resistance and appreciable voltage gain. Both properties are useful and they are the most used in FET linear circuits. Because of their low noise, FETs are often used in low-level audio frequency applications, e.g. in microphone head amplifiers where the high input resistance makes such amplifiers particularly suitable for following capacitor and piezo-electric microphones [4].

In general, a field effect transistor (FET) amplifier will have greater bandwidth than equivalent bipolar junction transistors (BJT) topologies. Since the input resistance for the FET is very large, modelled as infinity, the low frequency pole contributed by this resistance and C_{in} will occur at low frequency. In addition, the device capacitances associated with FETs are generally smaller than those for a BJT. This has the effect of raising the upper cut-off frequency of FET amplifier relative to an equivalent topology BJT amplifier.

This work intends to study of the effects of cascading multistage common source amplifier on gain and bandwidth [5].

Circuit Topology and Theoritical Considerations

The common-source amplifier has characteristics similar to those of the common-emitter amplifier of BJT's. However, the common source amplifier has higher input resistance than that of the common-emitter amplifier. The circuit for the common source amplifier is shown in Figure 1.0 [6].

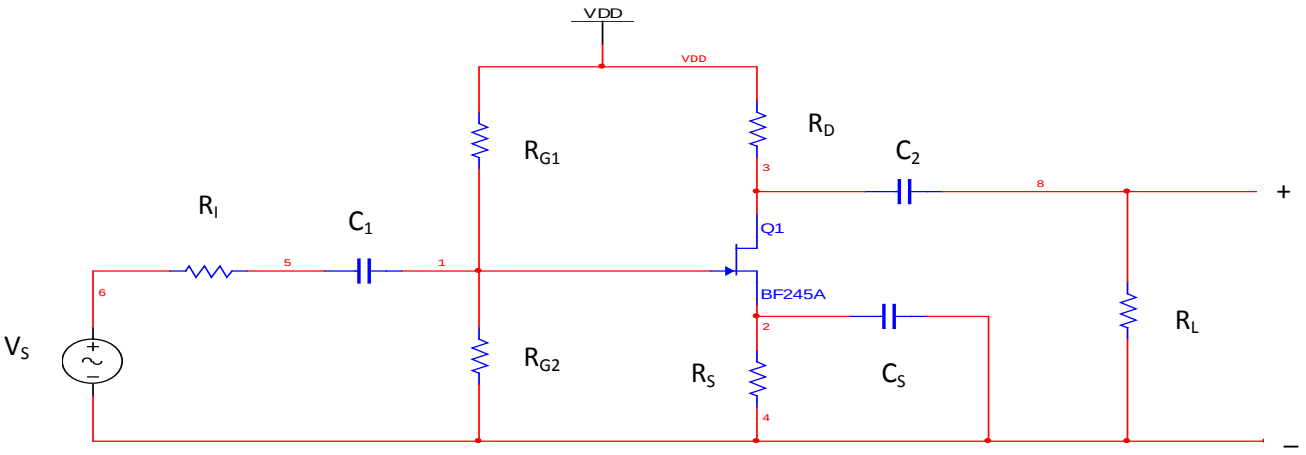

Fig. 1.0: Common source amplifier

The external capacitors C_1 ,C_2 and C_S will influence the low frequency response. The internal capacitances of the FET will affect the high frequency response of the amplifier.

The midband gain, A_m, is obtained from the midband equivalent circuit of the common source amplifier. This is shown in Fig. 2.0. The equivalent circuit is obtained by short-circuiting all the external capacitors and open-circuiting all the internal capacitances of the FET.

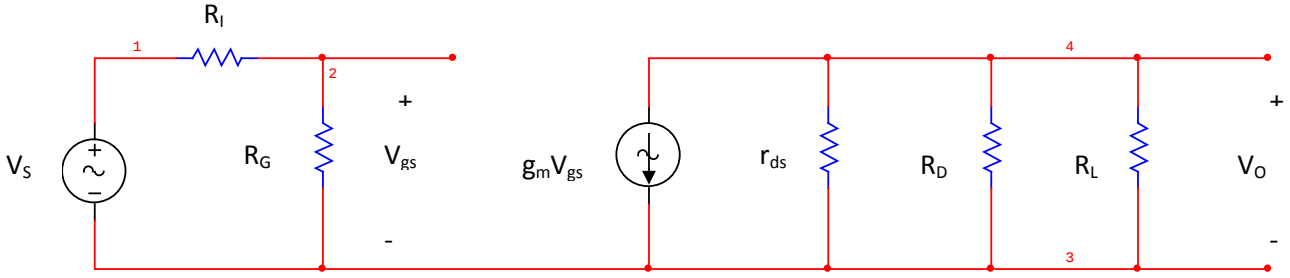

Fig. 2.0: Midband equivalent circuit of common source amplifier

Using the voltage division equation:

$$V_{gs} = \frac{R_G}{R_1+R_G} V_s \quad (1)$$

From Ohm's law,

$$V_s = -g_m v_{gs}(r_{ds} \| R_D \| R_L) \quad (2)$$

From Equation (1) and (2) the midband gain can be given as

$$A_m = \frac{V_0}{V_s} = -g_m \left(\frac{R_G}{R_G+R_1}\right)(r_{ds} \| R_D \| R_L) \quad (3)$$

At low frequencies, the small signal equivalent circuit of the common source amplifier is shown in Figure 3.0

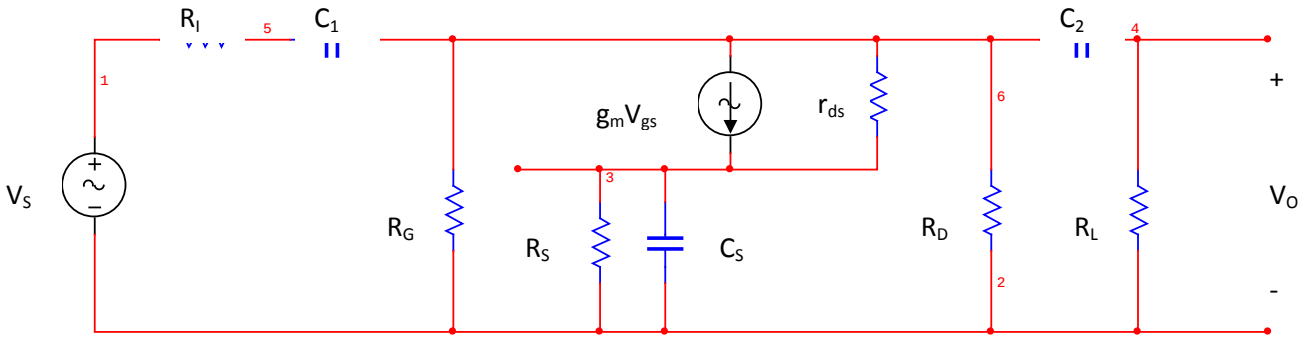

Fig. 3.0: Equivalent circuit for obtaining the poles at low frequencies of common source amplifier

The low frequency poles due to C_1 and C_2 can be written as

$$\tau_1 = \frac{1}{w_{L1}} \cong C_1(R_G + R_1) \quad (4)$$

$$\tau_2 = \frac{1}{w_{L2}} \cong C_2(R_L + R_D \| r_{ds}) \quad (5)$$

Assuming r_d is very large, the pole due to the bypass capacitance C_S is given by

$$\tau_3 = \frac{1}{w_{L3}} \cong C_S\left(\frac{R_S}{1+g_m R_S}\right) \quad (6)$$

and the zero of C_S is

$$w_z = \frac{1}{R_S C_S} \quad (7)$$

The 3-dB frequency at the low frequency can be approximated as

$$w_L \cong \sqrt{(w_{L1})^2 + (w_{L2})^2 + (w_{L3})^2} \quad (8)$$

For a single stage common source amplifier, the source bypass capacitor is usually the determining factor in establishing the low 3-dB frequency

The high frequency equivalent circuit of common source amplifier is shown in Figure

4.0. In the figure, the internal capacitances of the FET ,C_{gs} ,C_{gd} and C_{ds} are shown. The external capacitors are short-circuited at high frequencies.

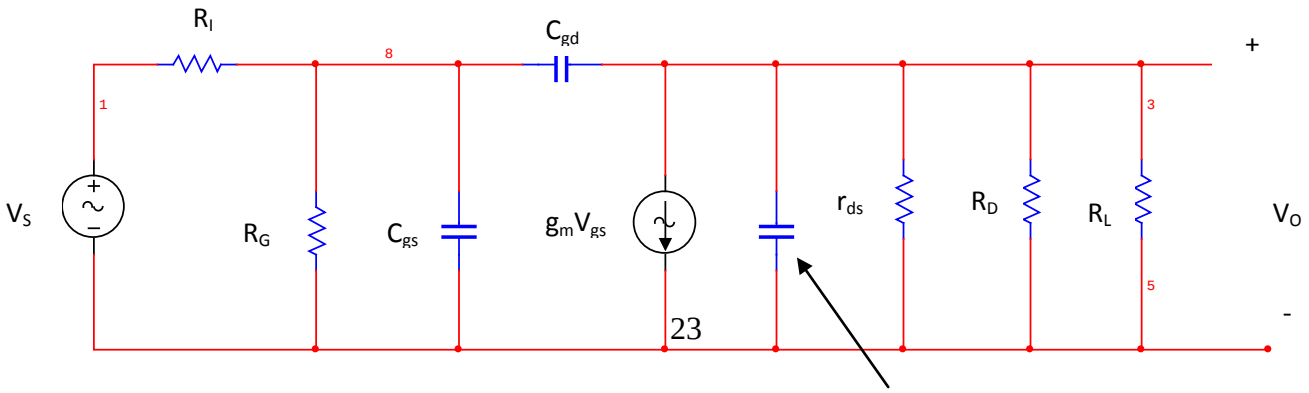

Fig.4.0 High **frequency equivalent circuit of common source amplifier**

Using the Miller theorem, Figure 4.0 can be simplified. This is shown in Figure 5.0.

The voltage gain at high frequencies is

$$A_V = \frac{V_0}{V_S} \cong -\left(\frac{R_C}{R_C+R_1}\right)\left(\frac{g_m R_L}{1+s(R_C \| R_1)C_1(1+sR_LC_2)}\right) \quad (9)$$

where

$$C_1 = C_{gs} + C_{gd}(1+g_m R_L) \quad (10)$$

and

$$C_2 = C \quad \quad C_{gd} \quad (11)$$

R_L C_{ds}

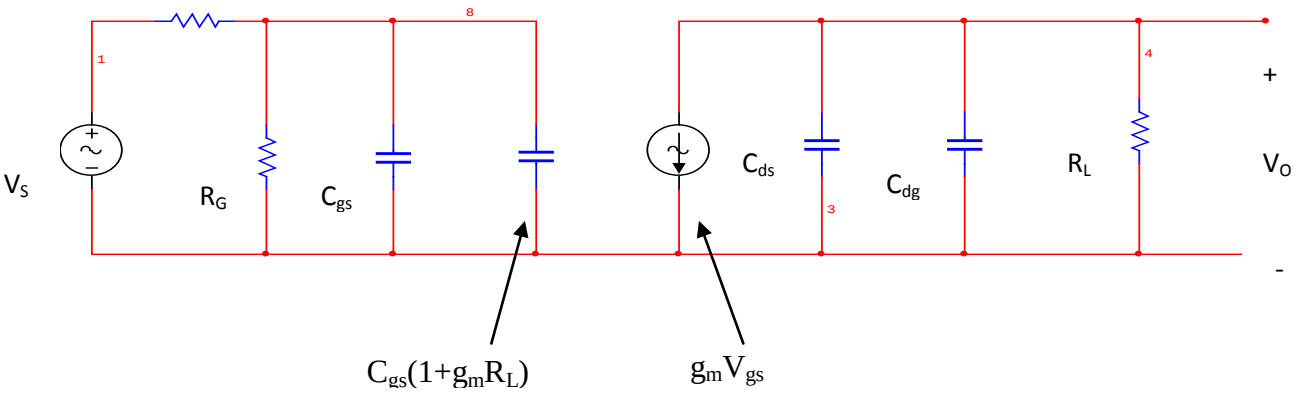

Fig. 5.0: Simplified high frequency equivalent circuit for common source amplifier

The high frequency poles are

$$W_{H1} = \frac{1}{C_1(R_C \| R_1)} \quad (12)$$

$$W_{H2} = \frac{1}{C_2(R_L \| R_D \| r_{ds})} \quad (13)$$

The approximate high frequency cut-off is

$$W_H = \frac{1}{\sqrt{\left(\frac{1}{W_{H1}}\right)^2 + \left(\frac{1}{W_{H2}}\right)^2}} \quad (14)$$

Gain-Bandwidth Considerations

Consider a multistage amplifier with a DC gain A_V and a $-3dB$ bandwidth ω_A. Let's consider that the multistage amplifier is formed from a cascade of *n* identical stages, each with a single pole response [7].

$$A_S(j\omega) = \frac{A_0}{1+j\frac{\omega}{\omega_B}} \quad (15)$$

Where A_V is the DC gain and ω_B is the $-3dB$ bandwidth of each stage. Assuming that there is no interaction among the stages, then the overall transfer function of the multistage amplifier is

$$A_V(j\omega) = \left(\frac{A_V}{1+j\frac{\omega}{\omega_B}}\right)^n, \quad (16)$$

And $A_V = A_v^n$

The $-3dB$ bandwidth of the multistage amplifier ω_A is the frequency at which

$$|A_V(j\omega_A)| = \frac{A_V}{\sqrt{2}} = \frac{A_V^n}{\sqrt{2}} \quad (17)$$

Thus

$$\left[\frac{A_V}{\sqrt{1+\left(\frac{\omega_A}{\omega_B}\right)^2}}\right]^n = \frac{A_V^n}{\sqrt{2}}, \quad (18)$$

And $1 + \left(\frac{\omega_A}{\omega_B}\right)^2 = 2^{\frac{1}{n}}$

where

$$\omega_A = \omega_B\sqrt{2^{\frac{1}{n}} - 1} \quad (19)$$

The above relation shows that the bandwidth of the multistage amplifier ω_A will be less than the bandwidth of the individual stages ω_B.

In general a cascade of *n* identical gain stages, each having a bandwidth ω_B, exhibits an overall bandwidth ω_A

$$\omega_A = \omega_B\sqrt[m]{2^{\frac{1}{n}} - 1}, \quad (20)$$

where *m* is equal to 2 for first-order stages and 4 for second order stages. The gain A_V and bandwidth ω_B of each stage can be written in terms of the overall gain A_V and bandwidth ω_A as

$$A_V = (A_V)^{\frac{1}{n}} \quad (21)$$

And $\omega_B = \frac{\omega_A}{\sqrt[m]{2^{\frac{1}{n}}-1}}$ (22)

An amplifier normally operates with signal frequencies between lower cut off frequency (f_1) and upper cut off frequency (f_2). If the signal frequency drops below f_1, the gain and thus the output signal level drops at 20dB/decade until the next critical frequency is reached. The same occurs when the signal frequency goes above f_2. The range (band) of frequencies lying between f_1 and f_2 is defined as the bandwidth of the amplifier, only the dominant critical frequencies appear in the response curve because they determine the bandwidth. Figure 6.0 below shows a typical amplifier frequency response.

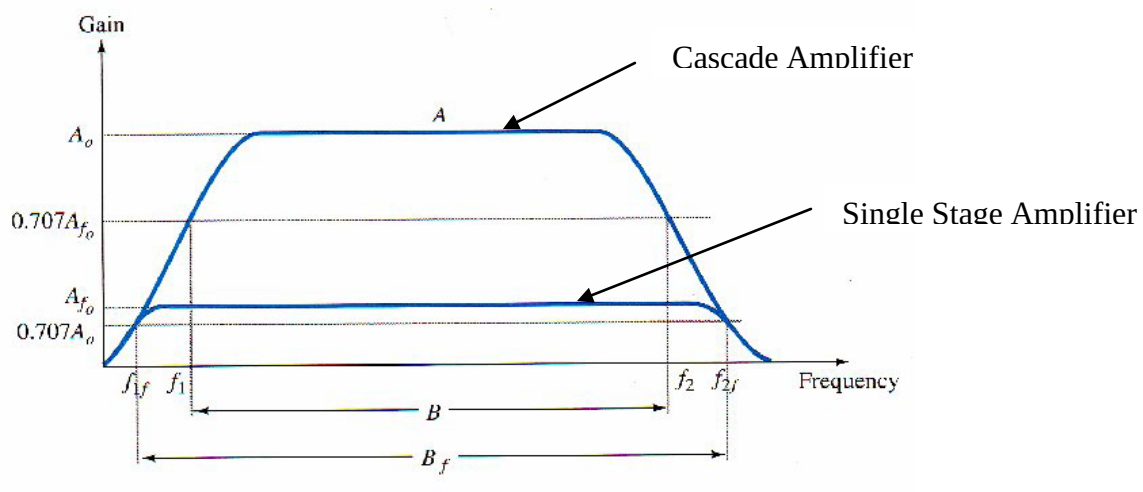

Fig. 6.0: The frequency response

As the frequency response curve shows, the gain of an amplifier remains relatively constant across a band of frequencies. When the operating frequency starts to go outside this frequency range, the gain begins to drop off. Two frequencies of interest, f_1 and f_2, are identified as the lower and upper cut off frequencies [8].

The amplifier's bandwidth is expressed in units of hertz as [8]:

$$BW = f_2 - f_1 \quad (23)$$

Method and Materials

In this research, a computer simulation using electronic software called MultiSim 8.0 was used. The drain and transfer characteristics data of JFET N-Channel BF245A were obtained as described below. For the transfer characteristics, the drain to source voltage (V_{DS}) was first adjusted to a reasonable value of 10V and the gate to source voltage (V_{GS}) was increased in small steps of -2.5, -2.0, -1.5, -1.0, -0.5 and 0V. The corresponding values of drain current (I_D) was recorded for each step. A similar procedure was used for different values of V_{DS} = 20V and 30V. The data obtained were used to plot a graph of V_{GS} along the horizontal axis and I_D along the vertical axis as shown in Figure 7.0. For the drain characteristics, the gate -to-source voltage (V_{GS}) was first adjusted to zero volts and the drain to source voltage (V_{DS}) was then increased in small suitable steps of 2, 4, 6...30V. The corresponding value of I_D was recorded for each step. A similar procedure was used for different values of V_{GS} = -1.5, -1.0, and -0.5V. The data obtained were used to plot a graph with V_{DS} along the horizontal axis and I_D along the vertical axis as shown in figure 8.0.

From figures 7.0 and 8.0, the values of V_P , I_D , V_{DD} , V_{DS} ,V_{GS} were obtained at the quiescent points. The drain current in the pinch off region depends upon the gate to source voltage and is given by the relation [9]:

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 \quad (24)$$

The pinch off region is the normal operating region of JFET when used as an amplifier.

The bias lines satisfy the equations [10]:

$$V_{GS} = -I_D R_S \quad (25)$$

$$V_{GG} = \frac{R_2 V_{DD}}{R_1 + R_2} \quad (26)$$

and

$$R_G = \frac{R_1 R_2}{R_1 + R_2} \quad (27)$$

Equation (27) only determines the ratio of the resistors R_1 and R_2 but in order to take advantage of the very high input impedance of the JFET as well as reducing the power dissipation within the circuit, there is need to make these resistor values as high as possible with values in the order of $1\ to\ 10M\Omega$ being common [11].

The drain to source voltage of the output can be determined by applying Kirchhoff's law as follows [12]:

$$V_{DS} + I_D R_D - V_{DD} = 0 \quad (28)$$

and

$$V_{DS} = V_{DD} - I_D R_D \quad (29)$$

To calculate the value of coupling capacitor C_1 or bypass capacitor C_S, the standard formulas to be used are [13]:

$$C_1 = \frac{1}{2\pi f R_{in}} \quad (30)$$

Where $R_{in} = R_G$ and

$$C_S = \frac{1}{2\pi f R_0} \quad (31)$$

where $R_0 = R_D$

The equations above were used to obtain the relevant parameters needed for the design of single stage amplifier. A single stage common source amplifier was designed, and then cascaded to obtain a two-stage amplifier, three-stage amplifier and finally a four-stage amplifier. For a single stage amplifier, the input voltage V_{in} and the output voltage V_o, were observed and recorded. At fixed input voltage of $40mV$, the frequency was increased step – wise to 1kHz, 10kHz, 100kHz, 1MHz, 10MHz, 100MHz and 1GHz. In each case, a corresponding value of the output voltage was observed and recorded. The gain in decibel for each variation of frequency was calculated from [14]:

$$A_V = 20log\left|\frac{V_{out}}{V_{in}}\right| \quad (32)$$

The data obtained were used to plot a graph of gain (dB) versus frequency (Hz) as shown in Figure 9.0. Origin 50 Software was used to plot the graph. In order to obtain the bandwidth, a screen reader from the menu of the origin to read values of lower cut-off frequency and upper cut-off frequency was used. The bandwidth is obtained as upper cut-off frequency minus the lower cut-off frequency. The same procedure was used for the two, three and four stage amplifiers. The input voltage ($40mV$) was constant at all frequency settings.

Results and Discussions

From this research some measured parameters and graphs were presented below**.**

Characteristics Curves

Figures 7.0 and 8.0 show the transfer and the drain characteristics of N-Channel BF245A JFET. Values of V_P, I_D, V_{DS}, and V_{DD} were obtained from them. Table 1.0 is a summary of the various quantities used in the design and their values.

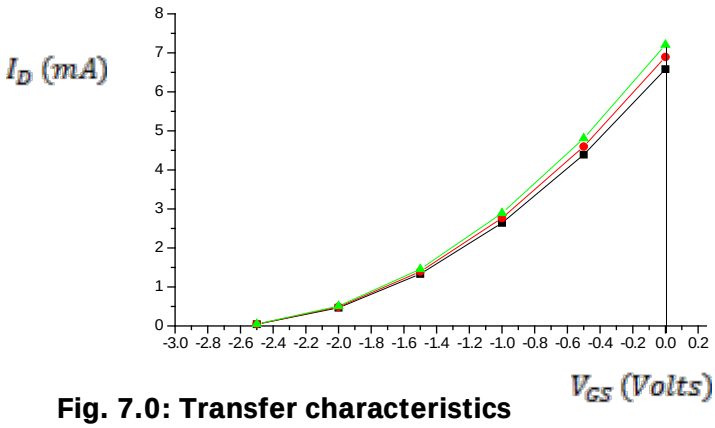

Fig. 7.0: Transfer characteristics

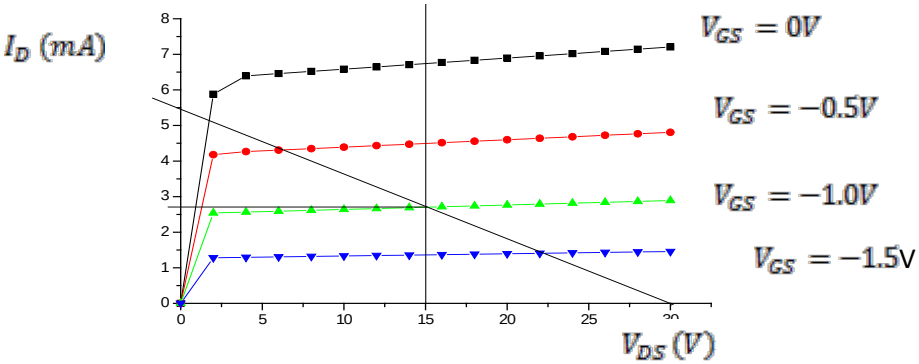

Fig. 8.0: Drain characteristics

Table 1.0: Calculated Parameters

Sn	Quantity	Symbol	Value
1	Drain current	I_D	$2.7mA$
2	Gate pinch-off voltage	V_P	$-2.5V$
3	Gate-to-source voltage	V_{GS}	$-1.0V$
4	Drain-to-source voltage	V_{DS}	$15V$
5	DC-supply voltage	V_{DD}	$30V$
6	Drain resistor	R_D	$5.6k\Omega$
7	Source resistor	R_S	370Ω
8	Resistor 1	R_1	$1M\Omega$
9	Resistor 2	R_2	$10M\Omega$
10	Coupling capacitors	C_1=C_2	$1.5nF$
11	Source capacitor	C_S	$270nF$

Single Stage Common Source Amplifier

The graph in Figure 9.0 shows the gain versus frequency for a single stage common source amplifier. The gain was obtained to be $24dB$ and the bandwidth was found to be $0.59GHz$. The gain is low at small frequencies, then rises as frequency increases, levels off for further increases in frequency, and then begins to drop at high frequencies. Response to a small signal - 100 Hz, and large signal -1GHz sine waves are shown in Figures 10 and 11 respectively.

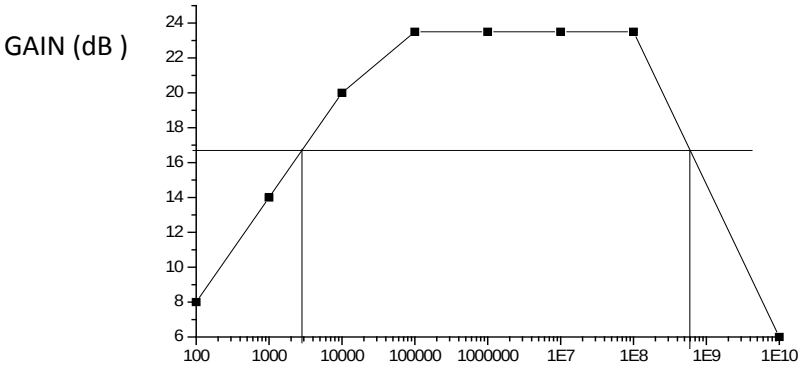

Fig 9.0 Graph of Gain (dB) versus Freq[illegible] CS Amplifier

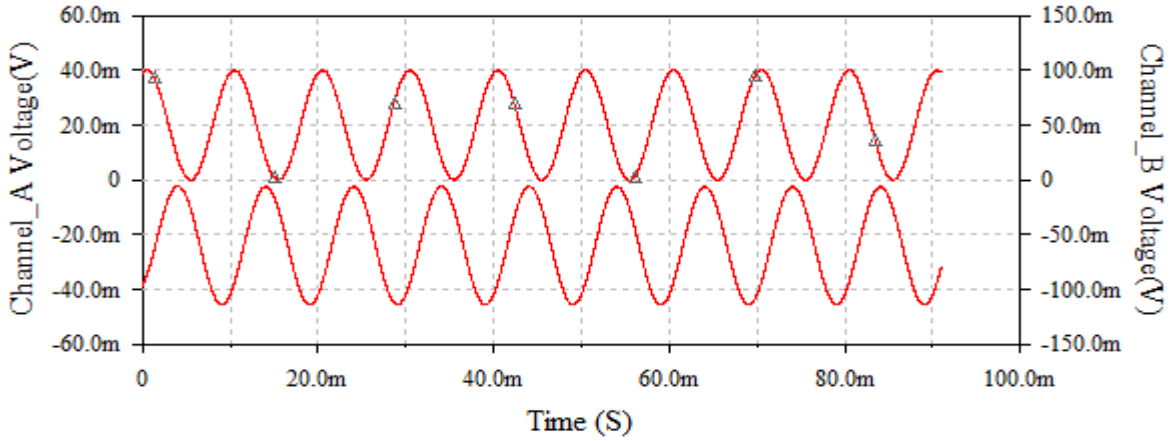

Fig 10: Single Stage JFT common source amplifier Response to a Small Signal-100Hz.

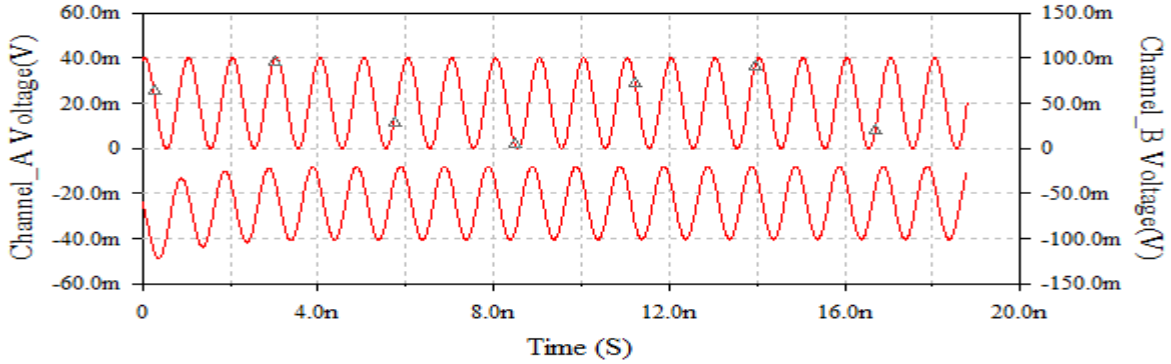

Fig. 11: Single stage JFT common source amplifier Response to a large Signal–1GHz.

Two-Stage Common Source Amplifier:

The graph in Figure 12 shows the gain versus frequency for a two-stage common source amplifier. The gain was obtained to be $34dB$ and the bandwidth was found to be $\approx 0.37GHz$. The gain is low at small frequencies, then rises as frequency increases, level off for further increases in frequency, and then begins to drop again at high frequencies. Response to a small signal - 100 Hz, and a large signal -1GHz sine waves are shown in Figures 13 and 14 respectively.

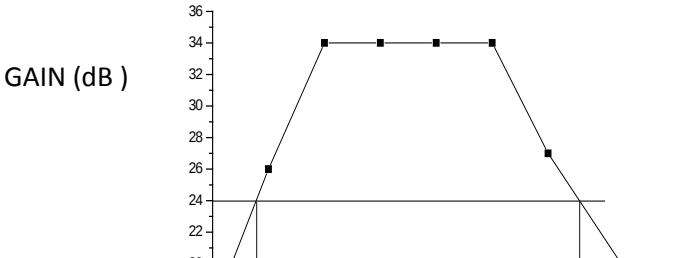

Fig. 12: Graph of Gain (dB) versus Frequency (Hz) for Two-stage CS Amplifier

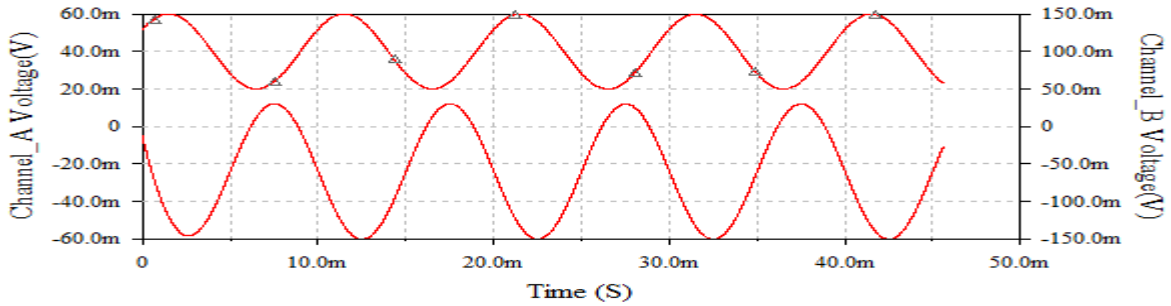

Fig. 13: Two Stage JFT common source amplifier Response to a Small Signal-100 Hz.

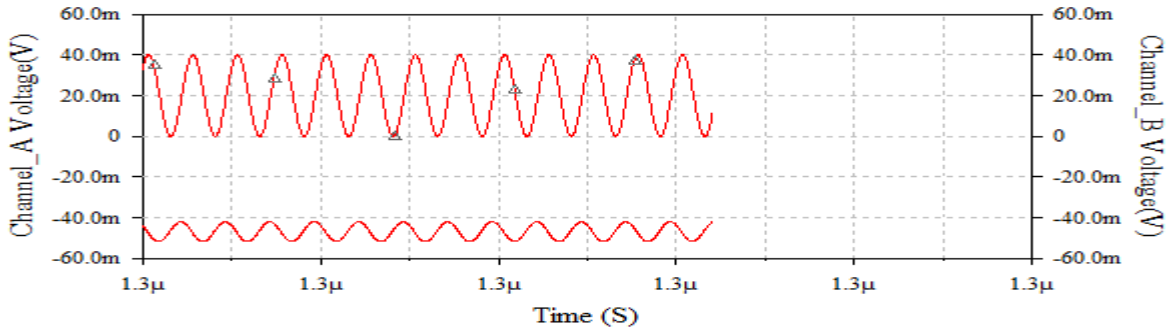

Fig. 14: Two Stage JFT common source amplifier Response to a Large Signal -1 GHz.

Three-Stage Common Source Amplifier

The graph in Figure 15 shows the gain versus frequency for a three-stage common source amplifier. The gain was obtained to be $46dB$ and the bandwidth was found to be $\approx 0.32GHz$. The gain is low at small frequencies, then rises as frequency increases, level off for further increases in frequency, and then begins to drop again at high frequencies. Response to a small signal - 100 Hz, and a large signal -1GHz sine waves are shown in Figures 16 and 17 respectively.

GAIN (dB)

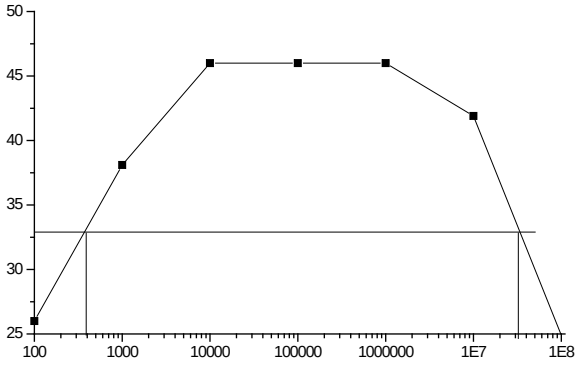

Fig. 15: Graph of Gain (dB) versus Frequency (Hz) for Three-Stage CS Amplifier

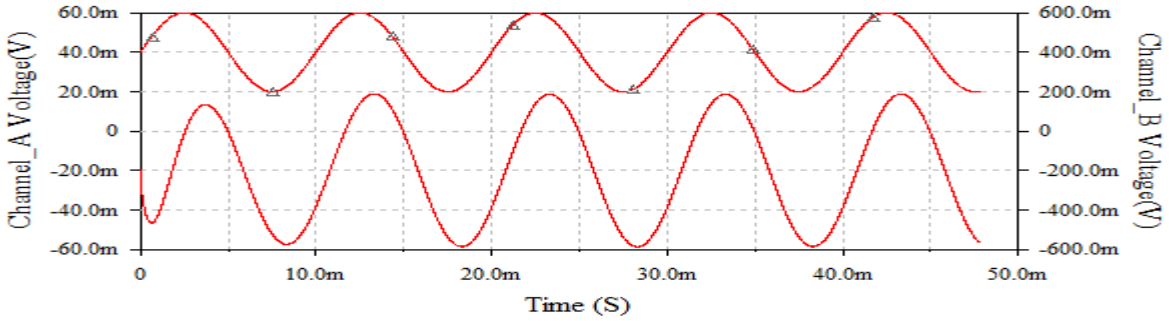

Fig. 16: Three Stage JFT common source amplifier Response to a Large Signal-100Hz

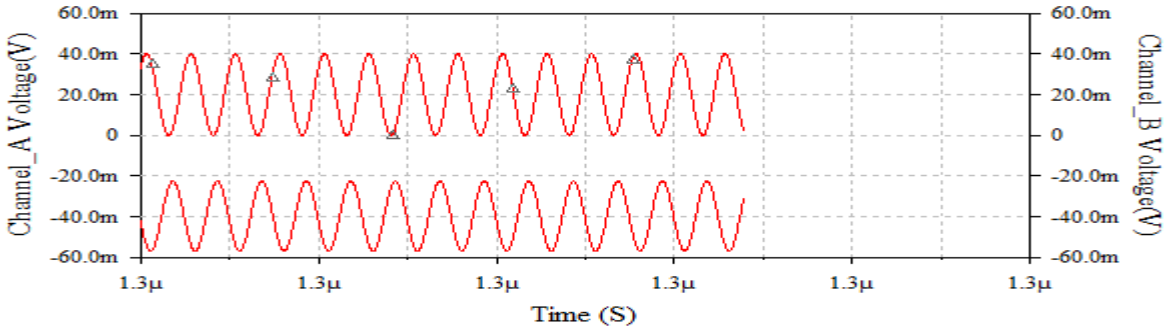

Fig. 17: Three Stage JFT common source amplifier Response to a Large Signal-1GHz

Four-Stage Common Source Amplifier

The graph in figure 18 shows the gain versus frequency for a two-stage common source amplifier. The gain was obtained to be $54dB$ and the bandwidth was found to be $\approx 0.29GHz$. The gain is low at small frequencies, then rises as frequency increases, level off for further increases in frequency, and then begins to drop again at high frequencies. Response to a small signal - 100 Hz, and a large signal -1GHz sine waves are shown in Figures 19 and 20 respectively.

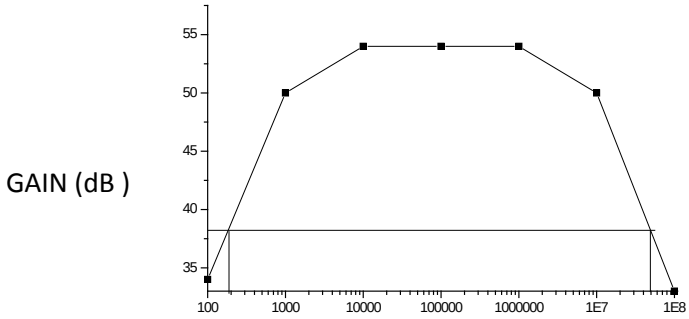

Fig. 18. Graph of Gain(dB) versus Frequency (Hz) for Four-Stage CS Amplifier

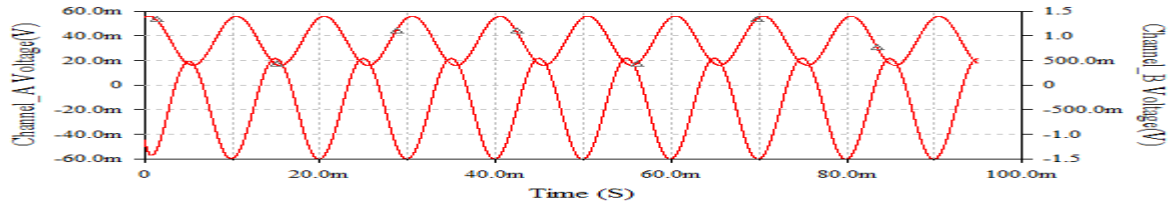

Fig 19: Four Stage JFT common source amplifier Response to 100Hz.

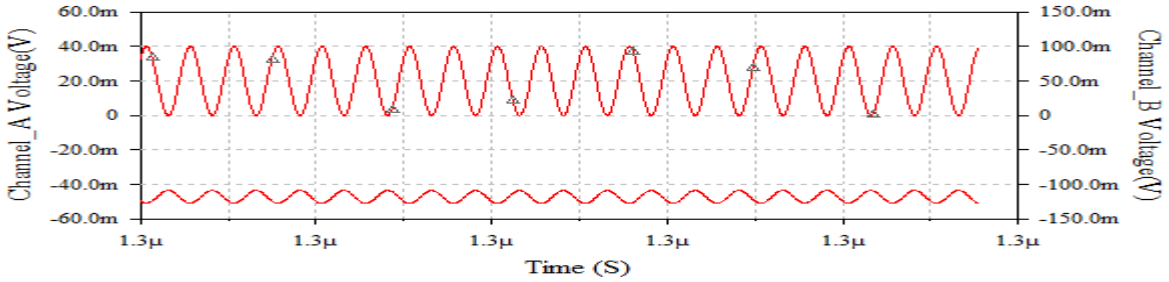

Fig. 20: Four Stage JFT common source amplifier Response to 100MHz.

Summary of Results

Amplifier Mode	Single stage common source amplifier	Two stage cascaded common source amplifier	Three stage cascaded common source amplifier	Four stage cascaded common source amplifier
Gain (dB)	*24*	*34*	*46*	*54*
Lower cut-off Frequency (Hz)	*2826.16*	*203458.90*	*389.11*	*188.6*
Upper cut-off Frequency (Hz)	*592619622*	*371308083*	*323929252*	*287332283*
Bandwidth (Hz)	*592616796* ≈ 0.59GHz	*371104624* ≈ 0.37GHz	*323928863* ≈ 0.32GHz	*287332094* ≈ 0.29GHz

Conclusion

In this work, investigation of the effects of cascading on a high gain broadband amplifier implemented with cascaded amplifier configurations for gain enhancement and bandwidth shrinkage is presented. In a nutshell, by way of simulation using multiSIM8 Electronics Workbench and calculation using load line analysis and relevant equations, the design of single stage common source amplifier, two-stage cascaded common source amplifier, three-stage cascaded common source amplifier and four-stage cascaded common source amplifier and studied the variation of their output voltage, with respect to frequency at constant input voltage of 40mV were achieved. The effects of cascading on gain and bandwidth were also realised. Study has shown that as the number of stages was increased, there was a corresponding increase in the gain at the expense of the bandwidth. This agreed with the theory that in a multistage amplifier, as the gain increases, the bandwidth decreases. Thus the decrease of bandwidth is proportional with the number of stages.

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VOLATILE ORGANIC COMPOUNDS (VOCs) POLLUTANTS IN TWO INDUSTRIAL AREAS IN LAGOS STATE, NIGERIA

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Abstract
VOCs are important class of air pollutants because they are ubiquitous and associated with increased short and long - term health risks in the industrial areas and environs. The air samples were collected by passive sampler (ORSA 5) from two contrastive industrial areas such as Ikeja and Isolo industrial areas. The air samplers were exposed to a height of 1.5 - 2.0m and sampling was carried out four times a month for a period of 12 months. The adsorbed VOCs were desorbed with carbondisulphide (CS_2) and the solution analysed using Gas Chromatography (GC) fitted with Flame Ionization Detector (FID). Twenty - Six (26) VOCs were captured in the Atmosphere of each of the studied areas. Seven (7) VOCs each were identified as the major contributors to ambient air pollution in Ikeja and Isolo industrial areas. There is a significant difference ($P_{value} < 0.05$) between the levels of VOCs in the studied areas. The meteorological parameters showed significant correlations with the ambient concentrations of VOCs. The monthly mean concentrations of the atmosphere total volatile organic compounds (TVOCs) in the studied areas show significant difference. The Principal Component Analysis (PCA) showed that the major sources of VOCs are mainly anthropogenic and four factors each were identified as sources of VOCs in each of the studied industrial areas with industrial emissions dominating in industrial areas.

Keywords: Pollutants, Contrastive, Gas Chromatography, Industrial, Anthropogenic.

Introduction

VOCs are important class of toxics air pollutants because they are ubiquitous and associated with increased short and long - term health risks in the industrial areas and environs for two distinct reasons. Firstly, they are precursors required for the photochemical production of atmospheric Ozone. Secondly, they include species that are individually carcinogenic and mutagenic in their own right (Pratt *et al,* 2000). The impact of any pollutant can be reduced by one of the following four ways which include (i) dilution of its concentration before it reaches any sensitive receptor (ii) collect the pollutant and dispose it in a way that prevents it from reaching most sensitive receptor (iii) collect and recycle the pollutant for some useful purposes (iv) Produce or prevent the emissions from occurring in the first place (Goodwin *et. al,* 1999). VOC pollutants are numerous including alkanes, alkenes, aldehydes and aromatics which vary in reactivity. The major oxidant responsible for their removal from the atmosphere is the hydroxyl radical (PORG, 1997). Volatile Organic Compounds are commonly encountered by people as they go about their daily routine. VOCs are carbon - based compounds that have vapour pressure to significantly vaporize and enter

the atmosphere (U.S EPA, 2005; EU, 2005; Estate Management, 2009). Studies have shown that VOCs enter the human bloodstream through the following means inhalation, ingestion and through the skin (ATSDR, 2001). They play an important role in the chemistry of the atmosphere; their role in the formation of photochemical smog and their associated oxidants, degrading air quality and threatening both human health and ecosystem (Molina *et al,* 2007). VOCs in industrial areas emanate from industrial activities of various industrial units and the products associated with them. These industrial units include ceramic and tile, lime and cement, energy, rendering, metal plating, refineries, slaughter houses, metal foundries, food industries, detergents, dry cleaners, dyeing industries, tanneries, dairies, oil mills, fisheries, hydrometallurgical processes, aluminum recycling, piggeries, poultry raising, breweries, cosmetics, canning industries, pharmaceuticals, wood processing units, paper mills, production of construction materials etc. The commulative risk from exposure to multiple VOCs and other air pollutants is not well known in Lagos and its industrial areas and limited evidence suggests that the minority population residing in industrial of Lagos state have disproportionately higher exposures (Kinney *et al,* 2002). It is generally believed that Children, Pregnant women and the elderly are at greater risk for developing disease from lower levels of exposure (Freedom *et al*, 2001).

The two Contrastive areas in this study are Ikeja and Isolo industrial areas. They are both located in Ikeja division of Lagos State on longitude 6.31 - 6.360N and latitude 3.19 - 3.20^0 E. The population within the Local Government was estimated at 313,196 - 521,509 people according to the 2006 final census result (NPC, 2009). Conspicuous in these areas are various types of industries which include paint, food and beverage, pharmaceutical, textile, soap, and detergent, heavy chemical, paper, paint, printing and publishing, cosmetic, breweries etc. There are also clusters of filling stations, shoppingmoore, eatries, motor parks, official and residential houses. The land - use pattern at Ikeja and Isolo industrial areas are mostly in dustrial and partly residential (Ojiodu, 2012)

The main objectives of this study are to: determine the types of VOCs Pollutants and the percentage contribution to pollution in the study area, the contributions of both natural and anthropogenic sources to VOCs emission in the areas of study.

Materials and Method

Sampling Locations

This study was conducted in Ikeja and Isolo industrial areas of Lagos state. Ikeja and Isolo areas lies within the tropical rainforest region with two distinct seasons: wet and dry seasons. The temperature throughout the year ranges between 21^0C and 30^0C. Humidity is relatively high while the rainfall ranges between 150mm - 200mm. The wind speed recorded during the study ranged between 3.20 - 6.00 ms^{-1}.

Selection of Sampling Site

10 samples were collected at ten sites from each of the studied areas. The sites were carefully chosen based on the following criteria: Cost of equipment, accessibility to the locations, freedom from any obstacle to free flow of air in the vicinity and security of the sampler. The locations (sites) were chosen to reflect activities in the areas. The geo - referencing was carried out by using GARMIN GPS MAP 76S.

Sampling Device and Collection of Ambient VOCs

Ambient air samples were collected using ORSA 5 diffusion tubes from Dragger Safety, Lubeck, Germany. The Sampler comprises a glass sampling tube open at both ends and filled with activated charcoal. Each opening in sampling tube is filled with cellulose acetate diffusion barrier. Ambient air diffuses into the sampling tube in a controlled manner. The cross section, tube length and

diffusion coefficient are constant and expresses the sampling rate (NIOSH, 1984). The diffusive (passive) sampler fulfilled many of the logistical requirements of an ideal ambient air monitor (Brown, 1999). A validation processes for diffusive sampler had been performed (Pfeffer *et. al*, 1995; ASTM, 1988).

Principle of the method

The sampling is performed through diffusion. The analyte is adsorbed on the activated charcoal and the surface of the charcoal attracts and holds the gases (adsorbate) by physical adsorption.

Sampling Routine

Sampling was carried out during dry and wet seasons. The samplers were exposed at a height of 1.5 - 2.0 metres. Sampling was done 4 times a month, for a period of 12 months. The samplers were harvested after seven days and taken to the laboratory for analysis. A total of 960 samples were collected for the two seasons. During each round of ambient sampling, meterological parameters such as temperature, wind speed, wind direction and rainfall were also recorded.

Table 1: Monitoring Locations, their Characteristics and Co - ordinates at Ikeja Industrial Area

Site	Code	Co-ordinates	Site Description
1.	IKEI	N 6^0 36' 40.5" E 3^0 21' 13.6"	This site is created at oregun road by Eleganza Industries. A location with heavy traffic density.
2.	IKOR	N 6^0 36' 33.9" E 3^0 21' 16.7"	Created at Oregun road by Seven - Up Bottling Company, PLC. A location with clusters of filling stations and commercial activities such as hawking of household items.
3.	IKOA	N 6^0 36' 07.0" E 3^0 20' 16.7"	Oba -Akran. This site is at Vitafoam, PLC. A location with high vehicular activities.
4.	IKOB	N 6^0 36' 07.5" E 3^0 20' 10.4"	Created at Obasa junction.
5.	IKNP	N 6^0 36' 05.2" E 3^0 20' 07.8"	This site created at Obasa road. A location with commercial activities such as hawking of cosmetic products, plastic and textile materials, footwears, food items.
6.	IKIP	N 6^0 36' 13.0" E 3^0 20' 13.1"	Created at Oba-Akran road by International paints for West Africa, PLC. (IPWA). A location with high traffic density.
7.	IKGI	N 6^0 36' 28.3" E 3^0 20' 10.4"	This site is at Oba – Akran road by Guinness Nigeria, PLC. A location with high vehicular activities.
8.	IKAJ	N 6^0 36' 26.0" E 3^0 20' 19.1"	Created at Adeniyi Jones by Dilux paint. A location with commercial activities such as hawking of household items.
9.	IKOS	N 6^0 36' 23.7" E 3^0 20' 31.9"	Olorunbe site. This location is made up of residential buildings with commercial stores such as pharmaceutical and paint shops
10.	IKAS	N 6^0 36' 00.6" E 3^0 20' 26.2"	This site is created at Ajao street, off Obafemi Awolowo road. A location with commercial stores and business centres.

Table 2: Monitoring Locations, their Characteristics and Co - ordinates at Isolo Industrial Area

Site	Code	Co-ordinates	Site Description
1	ISLT	N 6^0 31' 42.3" E 3^0 19' 49.9"	Created at Abimbola street by Limca junction. A location with many road intersections and high traffic density.

2	ISJW	N 6^0 31' 29.9" E 3^0 19' 48.2"	Abimbola site created at Abimbola street by Johnsonwax Industries, PLC. A location with high traffic density.
3	ISIM	N 6^0 31' 26.3" E 3^0 19' 54.1"	Ilasamaja International market site. A location where various types of products such as agricultural, household, petrochemicals, pharmaceuticals etc. are sold.
4	ISCB	N 6^0 31' 35.2" E 3^0 19' 58.5"	Created at Limca /Chesebrough way. A location with many road intersections and high traffic density.
5	ISMD	N 6^0 31' 44.9" E 3^0 20' 02.5"	Isolo-Apapa site. Created at Isolo - Apapa Express by mandilas. A very busy road with high human and vehicular density.
6	ISIJ	N 6^0 31' 23.8" E 3^0 20' 22.6"	Created at ile-iwe meta junction Bus-stop. A location with many road intersections.
7	ISRT	N 6^0 31' 55.4" E 3^0 19' 54.1"	Rotary site. A site located at Rotary road. A location with many commercial shops with road side mechanics.
8	ISIS	N 6^0 31' 48.8" E 3^0 19' 48.9"	Created at Isolo road. A location with high commercial and vehicular activities.
9	ISAF	N 6^0 31' 59.5" E 3^0 20' 07.7"	This site is located at Oshodi - Apapa Express road by Afprint, PLC. A location with high traffic density.
10	ISAM	N 6^0 31' 26.3" E 3^0 19' 58.1"	Created at Isolo way by Aswani - market. A location where textile and plastic materials are sold.

Analytical Methods

Extraction Process

After sampling, adsorption tubes were labeled and closed with special caps to avoid contamination and desorption. The samples were placed into tightly closed special plastic bags and kept in a freezer until they were processed. Before analysis, contents of both sections of the adsorbed tubes were placed into two different vials in which they were weighed, 10ml carbondisulphide (CS_2) was added as the extraction solvent to each tube (ASTM, 1988). Samples were extracted using a magnetic stirrer (Jenweary 1103) for 30min. The extracted samples were then filtered and stored in a freezer until they were analyzed using Gas Chromatographic instrument (GC) fitted with flame ionization detector (FID). The concentrations of the analyte were read from the calibration graph, which was done with standard solution.

Chromatographic Analysis

The extracted solutions were analyzed with gas chromatograph (GC) (Perkin Elmer Clarus 500) equipped with a flame ionization detector (FID). The GC / FID was standardized and calibrated by injecting about 2µL VOC - mix into it. The GC with a capillary column (Elite - V) (40m x 0.18 mm x i.d 1.0µm) was used with an initial oven temperature of 35^0C (held for 2min) increased to 60^0C at a rate of 4^0C min^{-1} (held for 0min) and finally to 225^0C at the rate of 40^0C min^{-1} (held for 5min). Helium was used as carrier gas at a constant flow rate of 45ml min^{-1}. The bake time was 8 min at

260^0C. The split ratio is 1: 40 and the injection and detection temperatures were maintained at 2500C and 280^0C respectively.

Chemical Standards and Instrumental Calibration

External calibration was carried out with a Volatile Organic Calibration Mix containing 40 VOCs in 2000mgl^{-1} in Methanol (Supelco, Bellefonte, U.S.A.). The calibration was performed by analyzing diluted standards. The standard solution was prepared by dilution in CS_2 /methanol for gas chromatography. Seven calibration levels of concentration range of 0.1 and 3.0 mg·L^{-1} (0.1, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0) with CS_2 was prepared from stock standard in a clean vial. They were freshly prepared at the moment of calibration. The instrumental calibration was performed by analyzing 2µl of the diluted standards, in order to obtain the relative response value (µv). The calibration results curve shows good linearity, with determination regression coefficient (r^2) greater than 0.999 for all the compounds.

Statistical Analysis

Two - way Analysis of Variance (ANOVA) statistical test was used to evaluate significance of the differences in means; we use correlation coefficient (r^2). Sources of emission were determined using correlation coefficient ($p < 0.05$) and the factor analysis (Principal Component Analysis) (SPSS, 2007).

Factor Analysis

The Principal Component Analysis (PCA) are the primary factor analysis techniques that uses eigen value to apportion data sets to identify emission sources, chemical interaction on meterological phenomenon depending on the data sets that have been submitted to PCA. It involves the classification of variables into groups that can then be associated with factors that contribute to pollutant levels at receptors.

Four factors were extracted from the data acquired at Ikeja Industrial areas. The first factor (F1) explained 38.35% of the total variance, second factor (F2) accounted for 30.69%, third (F3) and fourth (F4) factors were responsible for 23.0 and 7.69% of the total variance.

F1: This factor is loaded in xylene, isopropyl acelate, n - butylbenzene, n-propylbenzene and methylene chloride. The chemicals are used as solvent in paint, soap and detergent, cosmetic, pharmaceutical, paper and printing industries and also from hawkers of household materials like cloths, perfume and gift items like dinner sets. These chemicals are also released from vehicles in the studied area (Graham et. al, 2004). Therefore, factor 1 may be attributed to a combination of industrial solvent usage and vehicular emission.

F2: The high loading of factor 3 in ethanol, acetone, naphthalene and 4-methyl-2 pentanone. These are solvents used in paint, cosmetics and textile industries in the studied area (Wallace, 2001). Hence, factor 3 may be attributed to industrial solvent usage.

F3: Ethanol, benzene and ethylbenzene released from breweries, vehicules and people involved in gluing operations and tobacco smokers in the studied area is loaded in factor 3. Therefore, factor 3 is an indication of industrial and vehicular emission.

F4: Factor 4 accounted for 13.59% of the variance in the data. It was highly loaded in trichloroethane, 1, 2-dichloropropane and isopropyl acetate. These chemicals are used as solvents in cosmetics and paint industries in studied area. The source of factor 4 might be a combination of

solvent usage and industrial emission. Similarly, four factors were identified as contributing to the measured values in Isolo industrial area. The first (FI), second (F2), third (F3) and fourth (F4) factors accounted for 40.52, 25.26, 15.24 and 13.16 % of the total variance.

F1: This factor is highly loaded in ethylbenzene, isopropylbenzene, naphthalene, tuolene, trichloroethane and chloroform. These chemicals are used in cosmetics and paint industries and in the area. They are also released from petroleum products from petrol stations located in the area. Therefore, factor 1 is attributed to emissions from industrial solvent usage and petroleum products.

F2: Ethylbenzene, ethanol, chlorobenene and xylene is loaded in factor 2. These compounds are released from vehicle exhaust and petroleum products from petrol stations in the vicinity of the studied area (Rappengluck and Fabian, 1999). Factor 2 suggests vehicular and petroleum products emission.

F3: Factor 3 is highly loaded in ethanol, acetone and chloroform. These compounds are use as solvent in textile and paint industries in the studied area. Therefore, factor 3 is attributed to industrial solvent usage.

F4: Tetrachloroethane and trichlorofloromethane is loaded in factor 4. These are solvents used in paint and textile industries in the studied area. They are also released from refrigerator and air conditioner workshops in the area. Factor 4 is due to industrial solvent usage and evaporative emission.

The principal component analysis revealed that the major sources of VOCs in both Ikeja and Isolo industrial areas are mainly Anthropogenic and four (4) factors each were identified as sources of VOCs in the studied area with emissions from industries and traffic dominating.

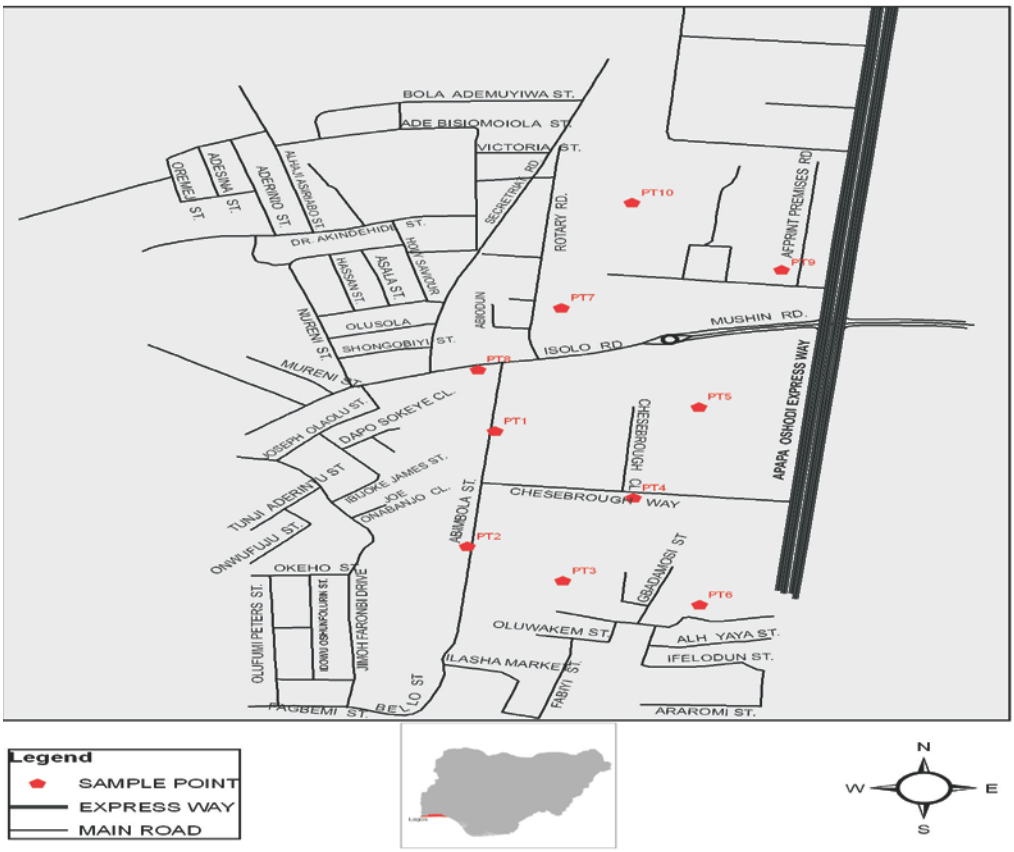

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Fig. 2: GIS map showing the sampling sites in isolo industrial area results and discussion

Table 3: Mean, Standard Deviation and Maximum Concentration of VOCs at Ikeja (n = 10) an Isolo Area (µgm^{-3}) (n = 10)

	Ikeja			Isolo		
	Mean	Std	Max.	Mean	Std	Max.
AROMATICS VOCS						
Benzene	27.04	0.96	31.85	13.43	1.14	14.11
Ethylbenzene	12.04	0.2	16.4	9.38	1.33	9.99
Isopropylbenzene	13.62	0.5	16.31	18.43	0.29	18.88
Napthalene	14.99	0.51	17.34	14.55	0.1	14.77
n-Butylbenzene	16.16	0.24	16.59	18.97	0.15	19.31
n-Propylbenzene	14.87	1.51	18.91	15.14	0.09	15.27
Toluene	22.28	1.04	26.14	14.03	0.16	14.37
m+ p – Xylene	63.67	0.08	73.69	31.3	0.21	31.64
o-Xylene	45.95	9.12	55.7	17.9	0.25	18.35
HALOGENATED VOCS						

BROMIDES						
Bromomethanez	26.34	0.77	27.84	10.24	0.13	34.19
Bromoform	15.17	5.44	15.5	16.23	0.18	23.24
CHLORIDES						
Chlorobenzene	22.08	1.01	23.14	18.7	0.13	10.42
Chloroform	26.87	0.55	27.89	15.16	0.04	16.51
Carbontetrachloride	21.38	1.03	21.31	18	0.2	18.91
Methylene chloride	20.13	1.42	17.96	13.17	0.1	15.22
Trichloroethane	15.45	0.85	15.71	12.1	0.08	15.22
Trichlorofloromethane	15.65	0.79	17.77	15.18	0.36	18.28
	16.1	1.05	17.66	14.15	0.05	13.37
2,2-dichloropropane	15.85	0.29	15.69	15.3	0.07	12.3
1,3-dichloropropane	ND	ND	ND	ND	ND	ND
Tetrachloroethane	14.34	0.14	14.55	14.48	0.29	15.64
KETONE VOCS						
Acetone	25.26	2.5	27.15	16.87	0.18.	15.46
2-Hexanone	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	12.18	0.32	12.69	12.19	0.19	17.02
NITRILE VOC						
Acetonitrile	ND	ND	ND	ND	ND	ND

Table 4: Total Variance (eigen values)

Initial Eigen Values

	Ikeja			Isolo		
Component	Total	% of Variance	Cumulative %	Total	% of variance	Cumulative %
Row 1.	151.09	61.9	61.89	1.618	66.36	66.361
2	51.127	20.904	82.8	0.326	13.39	79.753
3	21.647	8.864	91.67	0.161	6.604	86.357
4	13.49	5.526	97.19	0.126	5.154	91.511
5	3.26	1.336	99.11	0.095	3.894	95.405
6	1.425	0.184	99.67	0.043	1.767	97.172
7	1.365	0.559	99.88	0.041	1.662	98.834

Table 5: Total Volatile Organic Compounds (TVOC) at the Studied Areas (µgm^{-3})

SITES	IKEJA Mean ± SD (n = 10)	ISOLO Mean ± SD (n = 10)
1	550.6 ± 0.07	388.99 ± 27.24
2	561.05 ± 21.11	389.82 ± 34.16
3	583.56 ± 27.11	389.31 ± 24.17
4	569.14 ± 38.04	391.42 ± 30.36
5	583.56 ± 34.18	393.71 ± 34.10
6	584.78 ± 28.10	388.58 ± 18.63
7	565.33 ± 19.17	391.47 ± 22.74
8	553.84 ± 31.08	392.32 ± 24.96
9	540.81 ± 26.02	390.68 ± 27.17
10	571.80 ± 31.28	382.92 ± 28.58
TVOC	5669.47	3899.16

Twenty - Six (26) VOCs each were captured in Ikeja and Isolo industrial areas. The VOCs were classified thus: aromatics 41- 44%, halogenated 37- 42%, esters 3%, ketones 7-8%, alcohols 4-5%, ethers 2-4% (Table 3). Seven (7) VOCs each are the major contributors to pollution in Ikeja and Isolo industrial areas, such VOC Pollutants and their percentage contribution to pollution is as follows: xylenes 61.90%, isopropylbenzene 20.90%, isopropyl acetate 8.47%, n - Butylbenzene 5.53%, tuolene 1.34%, n - propylbenzene 0.58% and methylene chloride 0.56% (eigen value ≥ 1). The other nineteen (19) VOCs were able to contribute 0.12% to pollution in the area (Table 4). Similarly, in Isolo we have: ethylbenzene 66.36%, ethanol 13.39%, chloroform 6.60%, 2,2-dichloropropane 5.15%, xylene 3.89%, isopropyl acetate 1.77% and tetrachloroethane 1.66% the major contributors to air pollution in the area (Fig. 4). The other nineteen (19) VOCs were able to contribute 1.17% to pollution in Isolo. Ikeja (5669.47µg m^{-3}) is more polluted than Isolo (3899.16µg m^{-3}) industrial areas of Lagos state (Table 5). The total volatile organic compound (TVOC) in Ikeja is twice the value in Isolo (Table 4). This may be due to more industries and more vehicular traffic in Ikeja because of peoples patronage of such industries (Chang *et al* , 2005; Ohura *et al*, 2006; Hsieh *et. al*, 2003). The most polluted sites in Ikeja is IPWA site along Oba Akran avenue (site 6) while Isolo - Apapa express road (site 5) is the most polluted site in Isolo (Okuo *et al,* 2012). The

most abundant VOCs in the studied areas were BTEX and halogenated VOCs. The halogenated VOCs in the studied areas were dominated by bromomethane, chlorobenzene, chloroform, carbon tetrachloride, trichlorofloromethane and 1, 2 - dichloropropane (Table 3). Ikeja Industrial area has the highest BTEX and halogenated VOCs. The BTEX levels in Ikeja (Benzene 27.04, tuolene 22.28, ethylbenzene 12.04, 109.62 μgm^{-3}) while the halogenated VOCs (bromomethane 26.34, chlorobenzene 22.08, chloroform 26.87 carbon tetrachloride 21.38, trichlorofloromethane 15.65 and 1, 2 - dichloropropane 16.10 μgm^{-3}). Eleganza site has the most abundant BTEX (benzene 31.85, ethylbenzene 16.40, toluene 26.53 and xylenes 127.27 μgm^{-3}) (Table 3). Isolo - Apapa road has the most abundant BTEX in Isolo (benzene 14.11, ethylbenzene 9.99, toluene 14.10 and xylenes 49.89 μgm^{-3}) (Fig.2). The halogenated VOCs in the studied areas were dominated by bromomethane, chlorobenzene, chloroform, carbon tetrachloride, trichlorofloromethane and 1, 2 - dichloropropane (Table 3). The high concentration of ethanol in Oba - Akran 30.06 μgm^{-3} and Guinness 32.91μgm^{-3} both in Ikeja Industrial area is no doubt a reflection of the presence of brewery industries in the areas. The principal component analysis revealed that the major sources of VOCs in both Ikeja and Isolo industrial areas are mainly Anthropogenic and four (4) factors each were identified as sources of VOCs in the studied area with emissions from industries and traffic dominating.

Conclusion

Though, Ikeja has more industries than Isolo but the type of pollutants differs.

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FORECASTING NIGERIA FOREIGN EXCHANGE USING ARTIFICIAL NEURAL NETWORKS

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Abstract
Artificial neural networks (ANNs) are computing models for information processing and pattern identification. They grow out of research interest in modeling biological neural systems, especially human brains. An ANN is a network of many simple computing units called neurons or cells, which are highly interconnected and organized in layers. Each neuron performs the simple task of information processing by converting received inputs into processed outputs. In past two decades, ANN has been applied in Economics, Finance and other sectors. The foreign exchange market assists international trade and investment by enabling currency conversion. In this study we applied a time-delayed neural network model for forecasting daily foreign exchange rate of a US Dollar to Naira for Nigeria by using Artificial Neural Network (ANN) methodology on the basis of daily data for September 2011 to February 2012. We compared ANN with Single Exponential Smoothening (SES) and Autoregressive-Integrated-Moving-Average (ARIMA) models, the ANN forecasting tool proved to be more accurate than the SES and ARIMA as it had a smaller root mean squared error of 0.6995 as compared to the root mean squared error of the SES which was 0.9890 and ARIMA which was 0.7880. More research work can be carried out by comparing ANN with other available forecasting tools.

Key words: Artificial Neural Networks, Forecasting, Foreign Exchange Rate, Single Exponential Smoothening

Introduction

To forecast mean to predict. Forecasting is a process that produces a set of results by given a set of variables. Usually, the variables are past data. Fundamentally, forecasting assumes that future occurrences are depended, at least in fraction, on currently observable or long-ago events. Its assumption is that a number of aspects of the precedent patterns will keep into the future. Artificial Neural Networks (ANNs) are computing models for information processing and pattern identification. Artificial Neural Networks (ANNs) are branch of Artificial Intelligence (AI) systems. They are capable of correlating input and corresponding output data (Dayhoff & DeLeo 2001), (Piuri & Scotti, 2004), (Perantonis, *et al*, 1998) and (Huang & Ma, 1999), as a result they have become powerful tool in various applications. There are many organizations or institutions, for example: CZECH National Bank (Marek *et al*, 2005), Bank of Canada (Greg & Hu, 1999), Bank of Jamaica (Serju, 2002), to mention few, that are currently using their forecasting models based on ANN methodology for predicting various macroeconomic indicators. The capability of neural networks in modeling linear time series has been studied and confirmed by a number of researchers (Hwang, 2001), (Medeiros & Pedreira, 2001), (Zhang, 2001). There are numerous research works carried out using ANN (Nakamura, 2006), (Haider & Adnan, 2007), (Alhassan & Sanjay, 2011) to mention few.

The form of exchange rate for the global decentralized trading of international currencies is the foreign exchange rate market. Apart from weekends, financial centers around the world function as anchors of trading between a wide range of different types of buyers and sellers around the clock. It

is the foreign exchange market that determines the relative values of different currencies (O'Sullivan & Steven 2003). The foreign exchange market assists international trade and investment by enabling currency conversion. It also supports direct speculation in the value of currencies, and the carry trade speculation based on the interest rate differential between two currencies.

The main purpose of this paper is to forecast daily foreign exchange rate of US Dollar to Naira for Nigeria by using ANN methodology on the basis of available daily data from September 2011 to February, 2012. We also compare the forecast performance of the ANN model with that of Single Exponential Smoothening (SES) and Autoregressive-Integrated-Moving-Average (ARIMA) based models, because of problem of data over-fitting with SES and ARIMA. It is observed that forecasts based on ANN are more precise than those based upon SES and ARIMA models. The rest of the paper is organized as follows: Neural network methodology is presented in section 2. Section 3 provides data and methodology. Forecasting evaluation is discussed in section 4 and the last section is on the summary of our findings.

Literature Review

Artificial Neural Networks (ANN)

Usually called "neural network" (NN), is a mathematical model or computational model that tries to simulate the structure and/or functional aspects of biological neural networks. It consists of an interconnected group of artificial neurons and processes information using a connectionist approach to computation. In most cases an ANN is an adaptive system that changes its structure based on external or internal information that flows through the network during the learning phase. Modern neural networks are non-linear statistical data modeling tools. They are usually used to model complex relationships between inputs and outputs or to find patterns in data (Zhang, 2004).

Like human beings, ANN learns by experience. An ANN is configured for a specific application, such as pattern recognition and time series forecasting, through a learning process. In biological systems, learning involves adjustments to the synaptic connections that exist between the neurons. The basic building block of a brain and the neural network is the neuron. Figure 1 shows the human neuron.

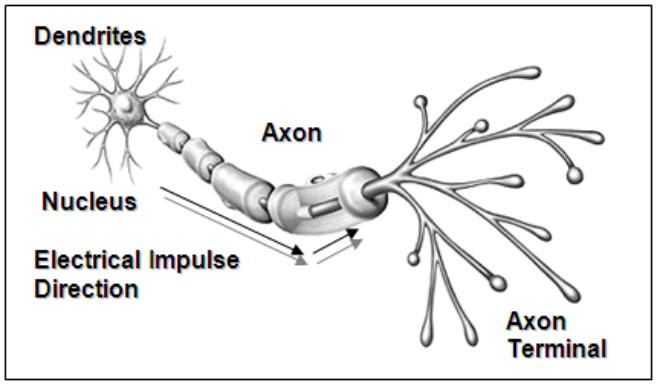


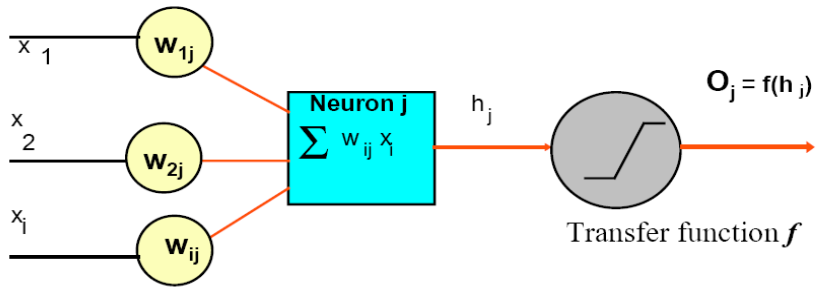
Figure 1: Biological Model of Human Neuron (Adapted from Haykin & Simon, 1994)

According to Beal and Jackson (1990), all inputs to the cell body of the neuron turn up along *dendrites*. Also, dendrites can act as outputs that interconnect inter-neurons. The function of dendrite is mathematically approximated as a summation. On the other hand, *Axons,* with electrical potential are found only on output cells. If excited, past a threshold, it will transmit an electrical signal. Axons terminate at *synapses* that connect it to the dendrite of another neuron. The neuron sends out spikes of electrical activity through a long axon, which splits into thousands of branches. Each branch a structure called a *synapse* at the end which converts the

activity from the axon into electrical effects that inhibit or excite activity from the axon into electrical effects that inhibit or excite activity in the connected neurons. As soon as a neuron receives excitatory input that is adequately large compared with its inhibitory input, it sends a spike of electrical action down its axon. By changing the effectiveness of the synapses so that the influence of one neuron on other changes, learning occurs. The human brain contains approximately 10 billion interconnected neurons creating its massively parallel computational capability.

Neuron Model

A neuron may be divided into three parts for analysis purpose. First, the input connections, second the summing and activation functions and lastly, the output connections. As shown in figure 2.



. **Figure 2:** An Artificial Neuron (Adapted from Zhang (2004) Documentation).

A neuron is connected to other neurons in artificial neural network and process the information it receives from them. No limit to the amount of connections a neuron may receive information from. The weights are used to regulate the information that a neuron receives from others. When a neuron receives information from other neurons, each portion of information is multiplied by a weight with a value between -1 and +1, which allows the neuron to judge how important the information it receives from its input neurons is. These weights are essential to the way a network works and is trained: in a reality, training a network means modifying all the weights and regulating information flow to ensure output follows the given criteria, for instance, minimization of root mean squared error or moving average error

Summing and Activation Functions

Summing and activation functions are the second part of a neuron. The information sent to the neuron and multiplied by corresponding weights is added together and used as a parameter within an activation function. A neuron becomes activated when it detects electrical signals from the neurons it is connected to in biological context (Beale & Jackson, 1990). If these signals are sufficient, the neuron will become “activated or excited” - it will send electrical signals to the neurons connected to it. There many activation functions used in ANN literature, but we will discuss the one which we used and that is hyperbolic tangent function: as in equation 1, a continuous function with a domain of (-∞,∞) and a range of (-1, 1):

$$\text{hyperbolic tangent: } f(x) = \frac{e^{x} - e^{-x}}{e^{x} + e^{-x}} \quad \text{..... Equation 1}$$

It is perfect for predicting whether or not inflation will rise (tanh(x) = 1) or fall (tanh(x) = -1), because it provides a function with a limitless domain and a range of (-1, 1).

Output Connections

Lastly, once the activation function returns a matching value for the summed inputs, these values are sent to the neurons that use the current neuron as an input. This process repeats again, with the current neuron's output being summed with others, and more activation functions accepting the sum of these inputs. It can only be ignored is if the current neuron is an output neuron. After which the summed inputs and normalized sum is sent as an output and not processed again.

Neural Network Architecture: Multilayer Perceptron

This was first introduced by M. Minsky and S. Paper in 1969. It is a special case of perceptron whose first-layer units are replaced by trainable threshold logic units in order to allow it to solve nonlinear separable problem. Minsky and Papert (Zhang, 2004) called multilayer perceptron of one trainable hidden layer. Each layer is fully connected to the next one. Depending on the complexity, performance and implementation point of view, the number of hidden layers may be increased or decreased with, corresponding increase or decrease in the number of hidden units and connections. Both the perceptron and the multilayer perceptron are trained with error-correction learning (Principe *et al*, 2000). But since perceptron does not have an explicit error available, this stopped further work on multilayer perceptron around 1970 until a method to train multilayer perceptron was discovered. The method is called back propagation or the generalized delta rule. With this method, processing is done from the input to the output layer, that is, in the forward direction, following which computed errors are then propagated back in the backward direction, to change the weights to obtain a better result. The algorithm has been rediscovered several times with some variations (Beeker & Le Cun, 1989). The theory about the derivation of back propagation learning rule can be found in the work of Rumelhart (Rumelhart *et al*, 1986) and Drakos (2003). Its structure is shown in figure 3.

The back-propagation (BP) algorithm is a generalization of the delta rule that works for networks with hidden layers. It is by far the most popular and most widely used learning algorithm by ANN researchers. Its popularity is due to its simplicity in design and implementation.

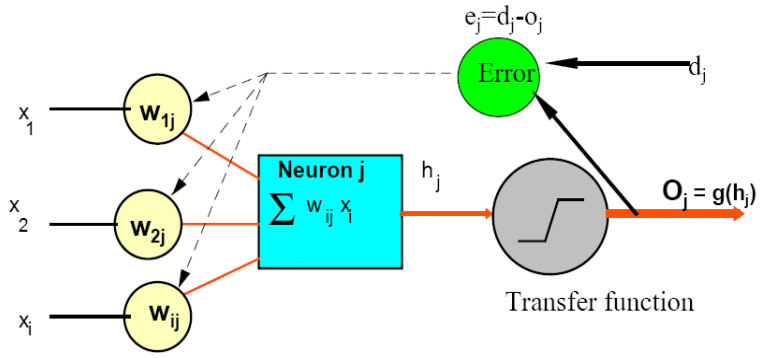


Figure 3: Back-propagation of errors for a single neuron j. (Adapted from (Zhang, 2004).

The algorithm for the back propagation is as follows:

(i) Perform the forward propagation phase for an input pattern and calculate the output error.

(ii) Change all weight values of each weight matrix using the formula

Weight (new) = weight (old) + learning rate * output error * output (neuron i) * output (neuron I + 1) * (1 – output (neurons i+1))

(iii) Go back to step 1

(iv) The algorithm ends, if all output patterns match their target patterns

When backpropagation algorithm is used for weight change, the state of the system is doing gradient descent; moving in the direction opposite to the largest local slope on the performance

surface. That is, the weights are being updated in a downward direction. The backpropagation algorithm is general, widely used and not complex, for raining multilayer feedforward networks.

Data and Methodology

Data Used

The main aim of this study is to forecast daily foreign exchange rates for Nigeria. The exchange rate of a US Dollar to Naira for the period of September 2011 to February 2012 using a time delayed artificial neural network model with 3 hidden layers. We used data on daily basis from 26 September, 2011 to 23 February, 2012. Figure 4 represents graphically the data we have used.

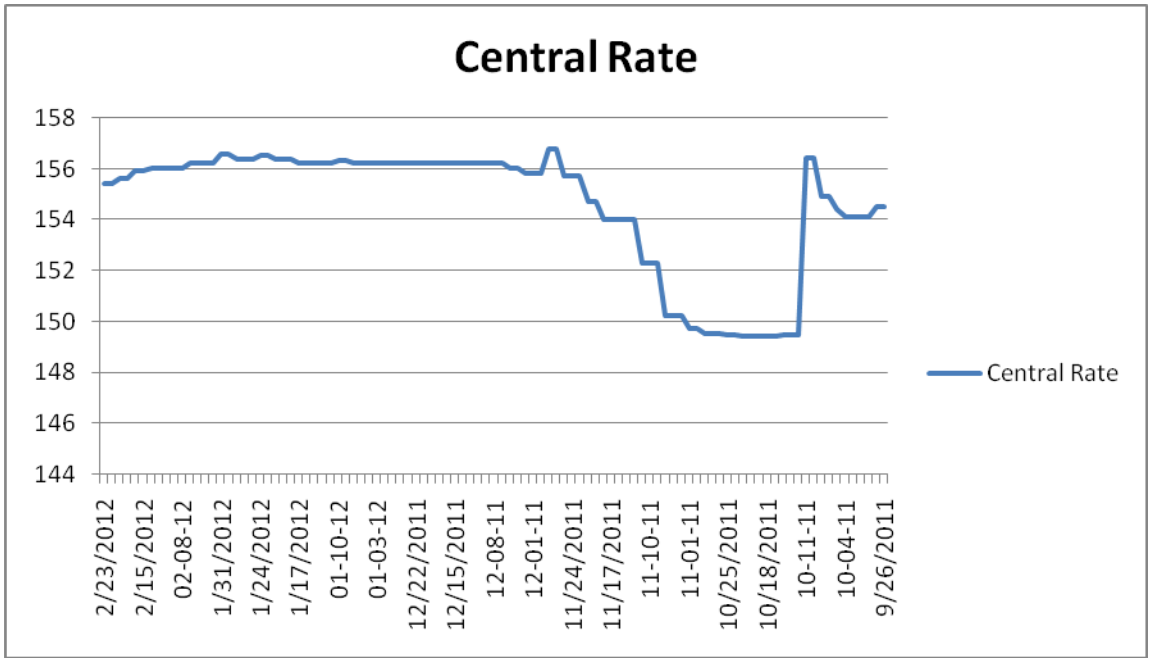


Figure 4: Graphical Representation of the data used

Model Description

We estimate a very time delayed neural network for foreign exchange rate based on *'feedforward with backpropagation'* architecture as in equation 2.

$$F_{t+j} = \sum_{k=1}^{n} \phi_k \text{Tanh}\,(w_k x_{t-1} + b_k) \qquad \ldots\ldots \text{ Equation 2}$$

Where: Ft+j is the neural network foreign exchange rate forecast *j* days ahead, xt-1 is a vector of lagged inflation variables [Ft-1, Ft-2] tanh which is the hyperbolic tangent function used as transformation process. ϕ's are layer weights, wi are input weights and b's are biases. The implementation is as follows; A Time-delayed neural network model was used to forecast the foreign exchange rate of US-Dollar to naira. This model is built to capture the relationship between the historical exchange rates and next week's exchange rate. In this model, the normalized exchange rates of the previous periods are fed to a neural network so as to forecast the next period exchange

rate. The formula for normalizing the raw data is given in equation 1. The inputs to the neural network are FX_{i-4}, FX_{i-3}, FX_{i-2}, FX_{i-1}, and FX_i, while the output of the neural network is FX_{i+1}, the next day's exchange rate where *FXi* stands for the current day's exchange rate. The FX_{i-1} means the current day exchange rate minus the previous week exchange rate, FX_{i-2} stand for the previous week exchange rate minus the previous two week exchange rate, as so on see equation 3.

$$Nm = \frac{2 * Y - (Max + Min)}{Max - Min} \qquad \text{. . . . . Equation 3}$$

We used equation 1 to achieved the original scaling of data within the range [-1 , +1]. Results are shown here in figure 5.

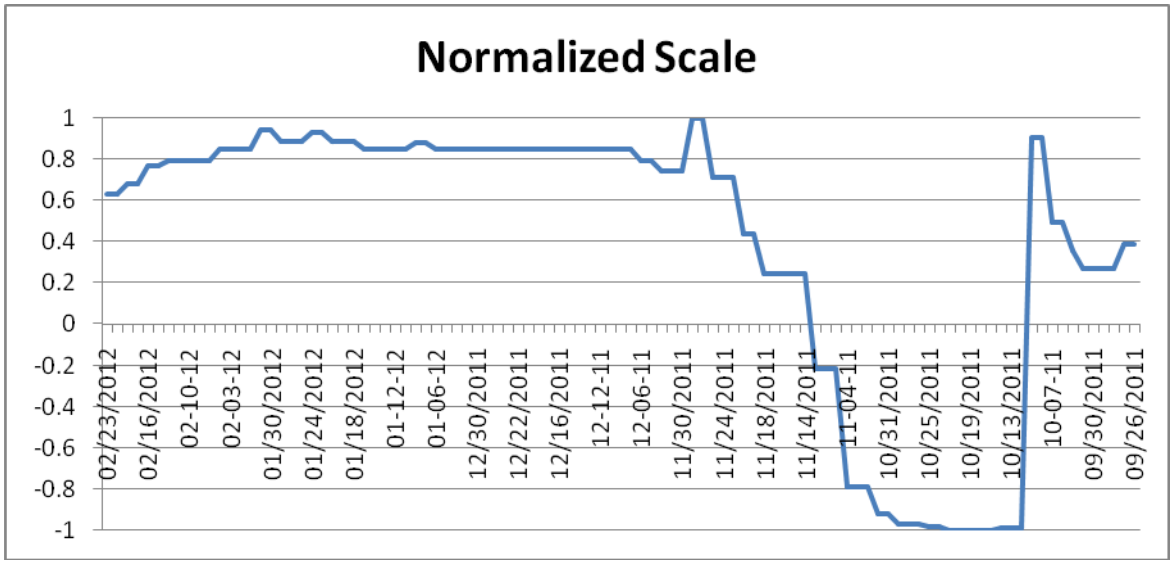


Figure 5: Foreign exchange rate in normalized scale [+1, -1]

Network Architecture

The architecture of this neural network is 5-3-1 where 5 represents the number of inputs to the network, 3 represent the number of hidden layers and 1 represent the number of output as shown in Figure 6. We use NMSE to measure the performance of this network.

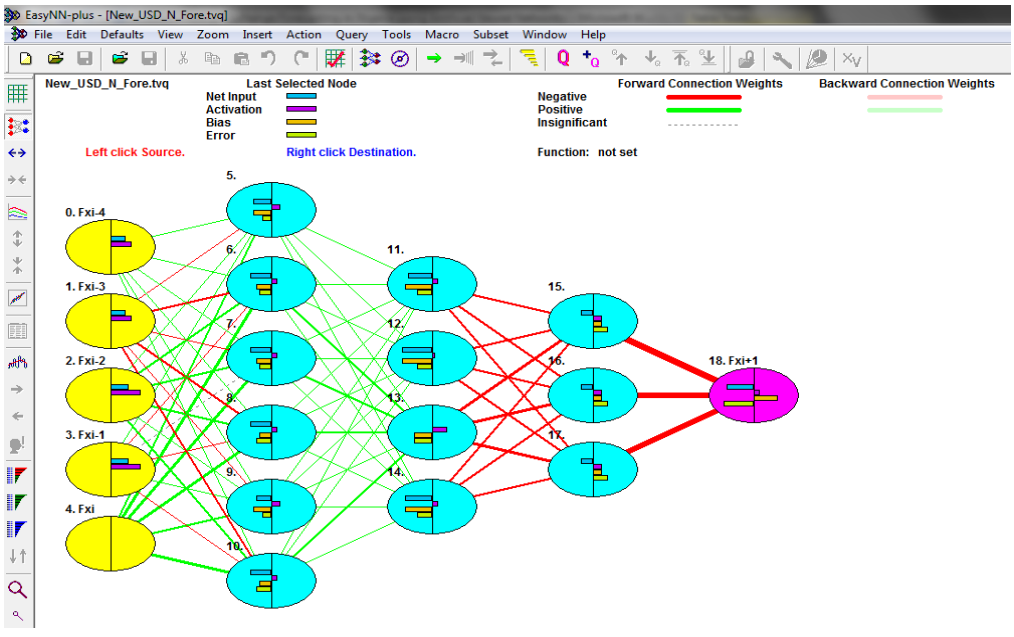


Figure 6: Architecture of the Artificial Neural Networks

Forecasting Evaluation

We calculate the root mean of squared errors (RMSE) to evaluate the forecast with the equation 4. The training algorithm is run on the training set until the RMSE starts to increase on the validation set.

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n} (Y_{it} - Y_{it})^2}{n}} \qquad \text{.. . . . .. . Equation 4.}$$

Our neural network was trained using the Easy Neural Networks. Before training, this model requires some default values, which are given in table 1.

Table 1: Neural network parameters used

S/NO	PARAMETER	VALUE
1	Hidden Layers	3
2	Training rows	101
3	Input Columns	5
4	Input Nodes connected	5
5	Learning Rate	0.6000
6	Learning Cycles	401
7	Target Error	0.0100
8	Momentum	0.8000

Comparing Forecast Performance of Ann and Ses and Arima Based Models

Compared the performance of the ANN with Single Exponential Smoothening (SES) and Autoregressive-Integrated-Moving-Average (ARIMA) using the same set of data. Results based on ANN methodology as well as both SES and ARIMA methodologies are presented in table 2. We evaluated forecasting performance on the basis of RMSE criteria. We observed that RMSE of ANN based forecasts is less than the RMSE of forecasts based on SES and ARIMA models. At least by this criterion forecast based on ANN are more precise.

Table 2: Comparison of the forecasting tools

TOOL	MIN. ERROR	RMSE
TNN	0.0000	0.6995
ARIMA(1,1,1)	0.2460	0.7880
SES	0.7880	0.9890

Conclusion

In this paper, a time-delayed artificial neural network model applied to forecast daily foreign exchange rate of a US Dollar to Naira for Nigeria by using ANN methodology on the basis of daily data for September 2011 to February 2012. The main reason of this work is to find reliable out-of-sample forecast based on RMSE minimization criteria, in which error instability is

minimized after training network with 3 hidden layers. The leaning rate of our model is 0.6. Feedforward with backpropagation methodology is used as model simulation; this requires an activation function which used generalized delta rule. From our forecast result, foreign exchange rate of a US Dollar to Naira for the end of next few days in February 2012 is on average high as compared with past days.In the end, we compared ANN with SES and ARIMA models, the ANN forecasting tool proved to be more accurate than the SES and ARIMA as it had a smaller root mean squared error of 0.6995 as compared to the root mean squared error of the SES which was 0.9890 and ARIMA which was 0.7880. More research work can be carried out by comparing ANN with other available forecasting tools.

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HANDWRITTEN ADDRESS DESTINATION RECOGNITION USING NEURAL NETWORKS

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Abstract
Most of the recent technological innovations are with some elements of artificial intelligence. This is replicated in this work to mimic the expertise of a post man in defining the destination of a posted mail. A system for destination address recognition of scanned addressed envelops image based on image processing and neural networks is developed. The system consists of three stages: preprocessing, neural network training and recognition. Neural network training is applied to find the aspects of address which are important for identification. The Neural network is used to create a number of 'state' database for the recognition of the destination of the address by using their weights. The system accepts hand-printed address block images as input. The main components of the system are image acquisition, image enhancement, address segmentation, feature extraction and character recognition. After extracting features of the address block on the envelope, the features extracted is used for the training and recognition of the destination address block. The system is trained with many samples to test the accuracy of the recognition of the neural network. The algorithm developed, is capable of distinguishing the city names in Nigeria on handwritten envelopes. In order to put the system to work in a real-time situation, the system architecture and related strategies are reported and experiments showed significant and promising results.

Keywords: Preprocessing, Neural Network, Image enhancement, Address segmentation and features extraction.

Study Background

Computer recognition of handwriting offers a new way of improving the human-computer interface. Since handwriting is one of the most familiar communication media, an automatic handwriting recognition system can offer a very easy and natural input method. Postal automation has always represented a main area of application for Image processing and Pattern Recognition techniques. Handwritten Character Recognition in mail processing has become an important part of mail delivery systems. The invention seeks to improve the effectiveness of sorting and delivery point processing in the post offices.

The handwritten character address block recognition is a challenging object recognition task due to the fact that address block varies in sizes and shapes. For a system to recognize the destination address block it requires relevant images for the successful training of the artificial neural network (Polikar, 2006). This required the techniques of machine and handwritten character recognition and low-level processing such as noise reduction, segmentation, features extraction and the actual recognition (Polikar, 2006).

Artificial Neural Network is used as a developed algorithm to train the network on how to recognize the destination address, which includes the city destination of the mail. The system requires that the handwritten character recognition must occur only on relevant portion of the envelope (Srihari&Kuebert, 1997).

The characters were prepared on a piece of blank paper envelop using varieties of writing pens and pencils. Purposeful sampling was used to obtain several samples of characters (each having different style) written by selected number of participants. These characters were captured using a scanning machine. The captured images were then preprocessed and used to generate input vectors for the backpropagation neural network for training. For the neural network training, separate character sets of some selected states (destinations) were also prepared using the same method as mentioned previously. Input vectors are generated and fed into the trained neural network for simulation. The program has the ability to capture the image on an envelope through careful filtering; analyze it, locate the destination address and then recognize the destination. The structure of the proposed neural network address recognition system is shown in Figure 1.

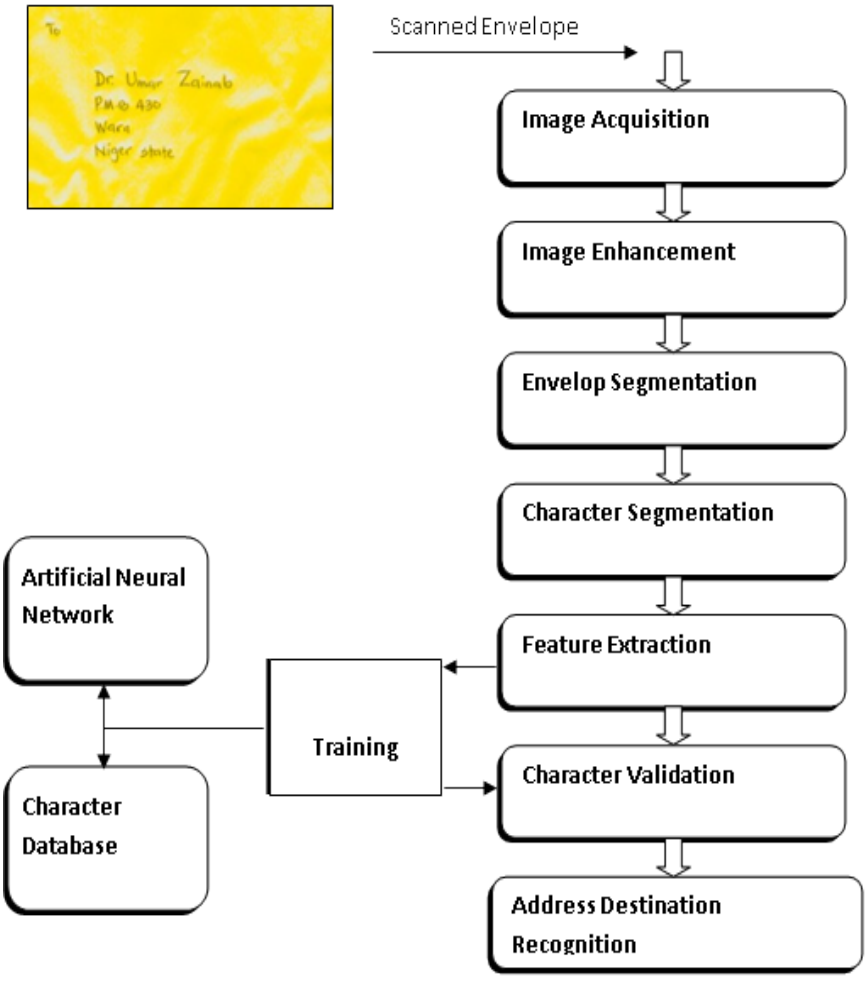

Figure 1: Simplified synopsis of the destination address recognition system

Statement of the problem

Today large volume mails increasingly demand faster, more reliable service and customized products. They require day-certain delivery, shipment and an electronic data interface. Mail-handling

is a very laborious process and the knowledge level required for the sorting process is quite demanding. For important destinations like large cities direct bundles are formed, but for small villages mail is combined into bundles and dispatched to regional sorting centers for further onward sorting. The introduction of new postcode containing information which could be used for the entire mail-handling process calls for a more sophisticated approach (Sridhar, 1993). Thus, automatic reading is necessary for all the address fields necessary from the carrier to the final destination.

Research Objectives

The purpose of this paper was to develop simulation model for recognizing the destination of address block on envelop for mail-handling process. In achieving the primary objective, the following specific objectives were formulated:

(i) To develop algorithm for the character recognition system based on neural network;
(ii) To implement algorithm to a real world case study of the postal service system.

Literature Review

Handwritten Character Recognition has been a very active area of research. It is defined as a class of pattern recognition problem because of its characteristics of variance in sizes, shapes and invariant in its translation, scaling and orientation (Park, 1999). Also spaces amid characters are not linear and this makes it difficult to separate the spaces in between text. Consequently, the handwritten character address block recognition problem is a challenging object recognition task. Earlier work on this topic can be divided into four major areas, depending on whether the recognition units are characters, words, phrases, or longer bodies of text (Trier, Jain &Taxt, 1996).

Character recognition is a process of classifying pre-isolated character images within a given alphabet domain (Park, 1999). Fundamental reviews are found in Mori, Suen& Yamamoto (1992); Nagy (1992); Suen (1992) and Mantas (1986). It includes many subtopics which may be roughly divided into the following categories: feature extraction and selection, classification method, and combination of classifiers (Trier, Jain &Taxt, 1995). The handwritten character address block recognition problem is a challenging object recognition task. However, most researchers have adopted the classical pattern recognition approach in which feature extraction and classification preceded image pre-processing.

Feature Extraction and Selection

Feature extraction serves as important step in achieving good performance for a character recognition technique. The Extracted features must be invariant to the distortions and variations that can be expected in a specific application. The size of the feature set is also highly significant in order to avoid dimensionality problem (Trunk, 1979). The type of selected feature can determine the nature and output of the preprocessing steps and depends on the nature of the features to be extracted. That is, the decision whether to:

(i) use gray-scale versus binary image,
(ii) fill representation or contour,
(iii) thinned-skeletons versus full-stroke images.

Features are obtained from coefficients of various orthogonal decomposition methods by the representation properties of the image data (Trier, Jain & Taxt,1995). Feature extraction methods using topological features can generally reconstruct the image from the feature set. Types of reconstructive feature extraction methods includefourier descriptors (Lin & Hwang, 1987 and Granlund,1992), geometric moment invariants (Teh& Chin,1988; Abu-Mostafa& Psaltis,1984 and Hu, 1962), Zernike moments (Bailey & Srinath,1996) and Wavelet descriptors(Wunsch&Laine, 1995).

There are two important characteristics for describing feature sets. These are global versus local and symbolic versus reconstructive (Elliman& Lancaster, 1990). In global feature extraction, a feature vector is obtained from the coefficients of the expansion base function and this has detailed description at the same time. While in symbolic feature extractions, the feature measurements are usually transformed into symbolic representations of geometric primitives such as line segments, convexity, concavity, convex polygons, projections etc. Examples of the symbolic feature extractions are Gradient-based features (Srikantan, Lam &Srihari, 1996), projection histograms (Glauberman, 1956) and gradient structural concavity (Favata&Srikantan, 1996). Selection of the best features for a given application is a challenging task. However, solutions to the feature selection problem are proffered by several references. For instance, an algorithm which selects the best subset from a pre-existing feature set to maximize classification through various driving functions (Jain & Zongker,1997 andKira& Rendelland,1992) and an algorithm which automates feature generation using a random generator based on information and orthogonality measures (Gader&Khabou, 1996).

Classification Method

Major approaches to classical pattern classification method are statistical based, structural analysis, template matching, and neural network approaches (Duda, Hart, & Stork, 2000 and Schalkoff, 1992). Significant progress has been made in these classification methods but more work is required to match human performance.

Acccording to Favataand Srikantan (1996), multiresolution feature have been found to be more advantageous in classification than conventional methods that work with features at a single scale. A multi-resolution recognizer such as the Gradient Structural Concavity (GSC) uses symbolic multi-resolution features. The Gradient of the image contour captures the local shape of a character. The Gradient features are extended to Structural features by encoding the relationships between strokes. Concavity features capture the global shape of characters. Similarly, Thegenerative models based on iterative computation have also been proposed as a dynamic approach to handwritten character recognition (Revow, Williams and Hinton (1996). A Bayesian interpretation of the fitting process is adopted to yield a practical recognition algorithm (Duda, Hart, & Stork, 2000). This model has additional advantages such as description of style parameters, recognition based segmentation, small size of template, and pre-normalization compared to conventional classification algorithms. However, this approach still has problems such as computational complexity because of the burden of additional features and iterative fitting process.

Combination of Classifiers

Many recent research has shown improved performance using a combination of several different classification algorithms. Parallel classifier combination methods have been extensively studied, including adaptive voting principle(Suen, 1992 and Revow, Williams & Hinton 1996), Bayesian formalism(Lee & Srihari,1995 and Xu, Crzyzak&Suen, 1992), Dempster-Shafer theory(Lu & Yamaoka, 1994), neural network(Lee and Srihari, 1995).

Word Recognition

The handwritten word recognition algorithms usually take two inputs: pre-separated word image and a lexicon representing possible hypotheses for the word image. This is intended to assign a matching score to each lexicon entry or to select the best lexicon entry among the set. Various approaches for handwritten word recognition can be grouped into two major approaches. These include the analytical (model based) approach and the holistic approach.

Analytical Word Recognition

The analytical approach is designed to recognize the input word image as a series of units of a predefined model set known to the unit classifier. In this case unit segmentation forms part of the

recognition process. Different model-based segmentation methods place different emphasis on the processes of segmentation and classification to reach the final recognition output (Simon, 1992).

Some of the most successful results have been achieved by segmentation driven techniques combined with matching algorithms of Dynamic Programming and Hidden Markov Models (HMM). In most cases a word image is segmented into sub-images called primitives without reference to the lexicon. Ideally a primitive is a character. Since perfect character segmentation is hard to achieve, in practice, an over-segmentation scheme is taken. A character segment can be a primitive or a union of primitives. All possible character segments are tried for matches with characters in the lexicon strings.

A recognizer that uses dynamic programming finds the prototype sequence which generates the best fit to the word image and yields the corresponding letter sequence as the recognized letter string or ranks the given lexicon with corresponding matching scores. Ordering primitives from left to right yields a partial ordering on the segments. A path though the partially ordered sequence of segments yields a segmentation driven by character recognition.

Holistic Word Recognition

Holistic approaches do not attempt to label parts of the image using sets of models (Farag, 1979). They extract holistic features from a word image and match the features directly against the entries of a lexicon. Holistic methods described in the literature used a variety of holistic features but they commonly include a variety of structural descriptions. Structural features are extracted from the image and they describe the geometric and topological characteristics.

These features are represented more robustly by a graph or a string of symbol codes, each code referring to a different feature or a combination of features. A location-coded string representation captures the locations in the image of each feature. The feature symbols and spatial relationships between features are represented by a graph representation that can show two dimensional relationships.

Some holistic classifiers have been developed for use in reduction of large lexicons and verification of recognition results obtained from other classifiers (Madvanath& Govindaraju,1995).

Word Recognition Combination

To optimize system performance, multiple word recognizer combination (Madvanath& Govindaraju,1995) and control strategies (Madvanath, et al.1996) have been proposed. In Madvanath, et al. (1996), multiple recognizers are connected in a serial path. A decision making strategy is applied at each intermediate connection on this path. At each stage, a recognition result can be produced if the recognition results are of a high enough quality. This control strategy achieves a better performance than that obtained by using a single recognizer only.

Phrase Recognition

Some character recognition and word recognition studies have been extended to text and phrase recognition in applications of postal address interpretation (Cohen, Hull &Srihari, (1994), bank check processing (Simon, Barat &Gorski, 1994) and tax form processing (Srihari et al., 1996). Previous research efforts related to handwritten phrase/text recognition problems most often assumes that words are already isolated or can be perfectly isolated.

The study of handwritten phrase recognition algorithms has been lacking compared to recognition of isolated units. Generally the scheme of phrase recognition systems follows the processing flow consisting of these steps: word segmentation, word recognition and post-processing. Separated

word images are sent to a word recognizer and contextual information and linguistic constraints are used in post-processing to complete the phrase selection process, assuming that word images are perfectly isolated.

Postal Automation

The main function required in postal automation, involving Computer Vision is definitely address reading and interpretation. Nevertheless, due to the inherent 2D nature of the problem its computer implementation is strongly based on basic technologies as image processing and pattern recognition. At present, the most challenging tasks, performed by such Vision technologies in postal automation, are handwiting cursive recognition, flats handling and reading, grey level and colour image processing, improved man-machine interaction, and robotic material handling.

Concept of Artificial Neural Network

Artificial Neural Networks has been widely used for pattern classification in a variety of fields including character recognition, speech recognition, image recognition and signal processing. The idea of neural networks is derive from the way neurons interact and how it functions in the natural animal brain, especially

Humans (Haykin,1998 and Bishop, 1995). Neural network have ability to learn how to solve problems based on the data given by training. Multilayer perceptron which can be trained based on back propagation is adopted in this research work.

The model consists of the following elements:

- Processing units (artificial neurons)
- Weighted interconnection (neurons connections)
- Activation rule to propagate signals through network
- Learning rule to specify how weights are adjusted

Neural networks is an information processing system composed of interconnected network of artificial neurons. Each neuron is linked to certain of its neighbors with varying weights.

The neural network is trained to learn from experience to solve different problems. In other words, neural network is a cellular system that can acquire, store and utilize experiential knowledge. Figure 2.Neural network training.The principal advantages of backpropagation are simplicity and reasonable training speed. It is well suited to Pattern recognition problem. The back-propagation algorithm (Cristea,1999)is given inFigure

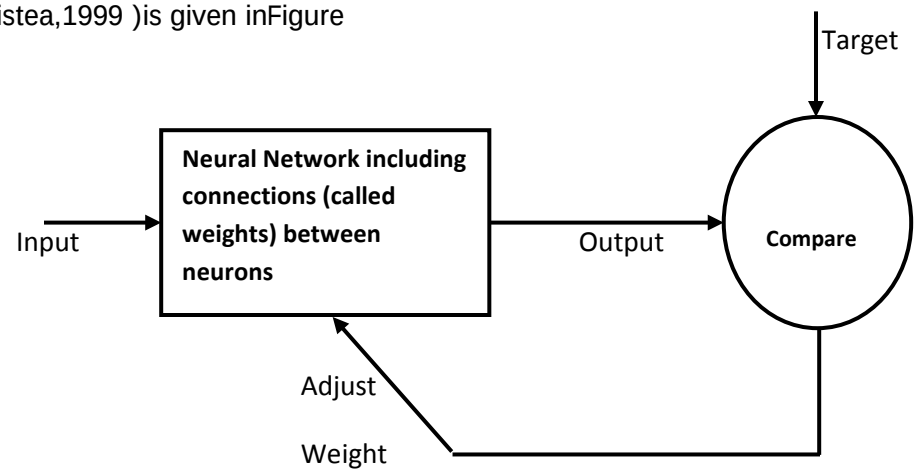

Figure 2: The back-propagation algorithm

The training is based on a gradient descent in error space, wherethe error is defined as:

$$E = \sum_P E_P \qquad (1)$$

Back-propagation algorithm:

1. Initialize all synaptic weights w to small random values.
2. Present an input from the class of learning examples (input/output pattern) and calculate the actual outputs.
3. Specify the desired outputs and evaluate the local error " for all layers.
4. Adjust the synaptic weights to minimize ".
5. Present another input pattern corresponding to the next learning example (repeat step 2).

whereE_P is the error of each input pattern and

$$E = \frac{1}{2}\sum_i (T\arg et_i - Input_i)^2 \qquad (2)$$

We can adjust the weights in step 4 corresponding to the gradient of error:

$$\Delta w = -\eta \nabla E \qquad (3)$$

whereη is a constant scaling factor defining the step-size of training. Once the neural network is trained, it can classify any incoming feature vectors effectively and accurately.

The ANN models have been developed in various disciplines to recognize patterns or approximate functions from complicated data and to make. The handwritten character recognition is complex and non-linear process, thus the neural network approach is appropriate for handwritten character recognition. Neural networks are composed of simple elements operating in parallel (Figure 3) The neuron model shown in Figure 4 is the one that widely used in artificial neural networks with some minor modifications on it.

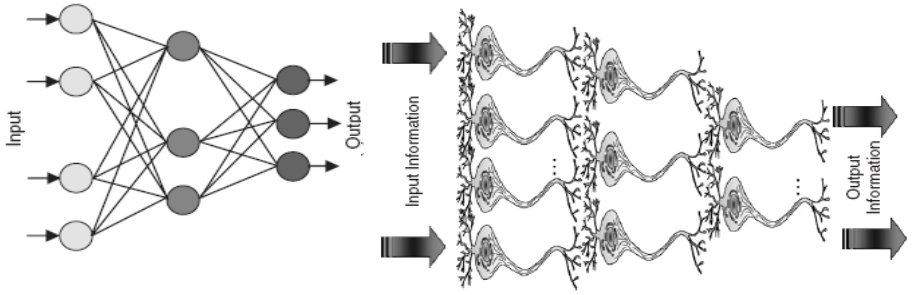

Figure 3: Neural networks

The artificial neuron given in this figure has N input, denoted as x_1, x_2,...x_N. Each line connecting these inputs to the neuron is assigned a weight, which is denoted as w_1,w_2,....,w_N respectively.

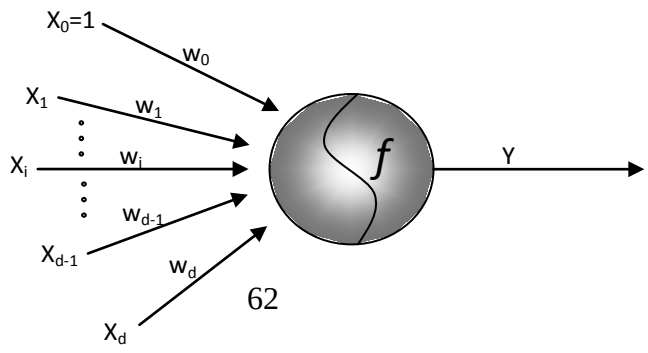

Figure 4: Artificial neuron

Methodology

Image preprocessing

Image preprocessing is defined as the extraction of appropriate invariant features that are then used for recognition system by the classifier system. Characters are preprocessed to improve performance of the pattern recognition system. This involves algorithm like scaling the characters to a standard size, reduction of noise in the character preprocessing algorithm may also be employed to make the character images font–independent

Image acquisition

The approach used for the envelope acquisition was to scan the image horizontally looking for repeating contrast on the scale of the pixel. The particular value is determined by the resolution of the scanner. 100dppi resolution was chosen for the scanned image. Some amount of skew is usually introduced when a document is scanned. Before any further processing it is necessary to ensure that the document is aligned properly. There can be skew associated with entire document or with individual characters. In both cases, it needs to be corrected before further processing. The nearest neighborhood clustering method is used to determine the skew.

Image enhancement

In image analysis and enhancement problem it is very essential to identify the object of interest from the rest. The handwritten address on the envelope is removed from the background pixel. The segmented uses black as background image and the foreground is white Image segmentation tends to partition the scanned into two exclusive and collectively.

Features extraction

A feature is a component representation of the information content in data. At each feature location (peak) a feature vector is extracted which describes the local neighbourhood surrounding the peak. Sobel gradient operator was applied on the pre-processed image on the characters on the envelope. The features of the characters extracted are fed into the neural network for its training.

Training process

The original document is scanned into the computer and saved as an image. The code breaks the image into sub-images, each containing a single character. The sub-images are then translated from an image format into a binary format, where each 0 and 1 represents an individual pixel of the sub-image. The binary data is then fed into a neural network that has been trained to make the association between the character image data and a numeric value that corresponds to the character. The output from the neural network is then translated into ASCII text and saved as a file as illustrated in Figure 5.

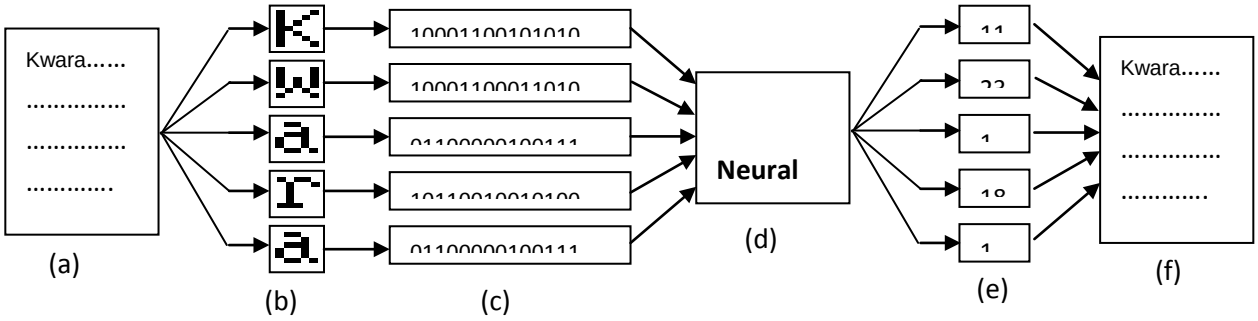

Figure 5: Training process

(a) represents image of a scanned envelop.
(b) represents sub-images of individual destination of the address from envelop.
(c) represents Binary representation of the sub-images obtained by morphological binarization techniques. i.e 0 is white and 1 is black.
(d) represents the supervised neural network which is trained to recognize images of the characters.
(e) represents the neural network output i.e. numeric values corresponding to the recognized characters.
(f) represents file containing the text of the scanned document.

Analytic techniques

It is well-known that reasonable models for human vision system are basically computational. In this research we develop theory for automated understanding of observed images and recognition of interesting objects in the images. Using ideas from Young, Gerbrandsand Van Vliet (1998) we seek to: derive efficient representations of arbitrary scenes; derive probabilistic models for these representations and write algorithms for statistical inferences.

Segmentation

The basic idea of image segmentation is to group individual pixels together into regions if they are similar. Similar can mean they are the same intensity (shade of gray), form a texture, line up in a row, create a shape, etc. The techniques that are used to find the objects of interest are usually referred to as *segmentation techniques.* In the preprocessing stage it is essential that we can distinguish between the objects of interest and the background i.e segmenting the foreground from background. In this project we will employ two of the most common techniques i.e. *thresholding* and *edge finding. Also* we will present techniques for improving the quality of the segmentation result.

Thresholding

In this technique we consider a chosen parameter θ called the *brightness threshold* which is applied to the image $a[m,n]$ as follows:
For dark objects on a light background we would use:

$$\text{If } a[m,n] < a[m,n] = \textit{object} = 1$$

$$\text{Else } a[m,n] = \textit{background} = 0 \qquad (4)$$

Thus, this algorithm assumes that we are interested in dark objects on a light background.

The computed global image threshold is achieved using Otsu's method with Matlab in the course of this research as follows:

```
Image_thresh = graythresh(image)                    (5)
```

The graythresh function chooses the threshold to minimize the intraclass variance of the black and white pixels. Figure 6 shows an example of their text extraction process. We see that there is an intimate relationship between edges and regions.

Figure 6: Intermediate stages of processing (a) original address envelop; (b) image segmentation; (c) after edge finding; (d) after binarization and dilation.

The group of pixel, the handwritten address on the envelope is removed from the background pixel. The segmentation uses black as foreground image and the background is white. The image binarization converts the scanned characters on the envelope to its binary form 0's and 1's.

Edge finding

After the thresholding that produces a segmentation that yields all the pixels that belong to the objects of interest in the image. The next step is to find those pixels that belong to the borders of the objects. Techniques that are directed to this goal are termed *edge finding techniques*. There are many techniques available for image *edge finding*, and they vary in complexity, power, and area of application. The Sobel method is employed and this finds edges using the Sobel approximation to the derivative. It returns edges at those points where the gradient of Image is maximum. The sobel gradient filters are specified as follows (Young, Gerbrands& Van Vliet,1998):

$$[I_x]=\frac{1}{4}\begin{bmatrix}1 & 0 & -1\\ 2 & 0 & -2\\ 1 & 0 & -1\end{bmatrix}=\frac{1}{4}\begin{bmatrix}1\\ 2\\ -1\end{bmatrix}\bullet\begin{bmatrix}1 & 0 & -1\end{bmatrix}$$

$$[I_y]=\frac{1}{4}\begin{bmatrix}1 & 2 & 1\\ 0 & 0 & 0\\ -1 & -2 & -1\end{bmatrix}=\frac{1}{4}\begin{bmatrix}1\\ 0\\ -1\end{bmatrix}\bullet\begin{bmatrix}1 & 2 & 1\end{bmatrix} \quad (6)$$

Features extraction

A feature is a component representation of the information content in data. At each feature locationx, we would like to extract a feature vector which describes the local neighbourhood surrounding x. Sobel gradient operator was applied on the pre-processed image on the characters on the envelope, where features of the characters are extracted to serve as input into the neural network for its training.

Classify Character

Once segmented characters are represented by feature vectors, a host of pattern classification techniques can be applied. We have used the training method described earlier chapter 2 that produces multi-layer feed-forward back-propagation Neural Network with performance equal or better than character recognition. This is achieved with a single three_layer network by making fundamental changes in the network optimization strategy as discussed earlier2. A network of size 128x128x26 was used to classify the alphabetic character.

Training and Simulation of Neural Networks for Recognition

Neural networks have been trained to perform complex functions in various fields of application including pattern recognition, identification, classification, speech, vision and control systems. In this paper, there is one neural network for subimages of individual letter from word document. The feature vectors are calculated for the sub-image on the address envelop. These feature vectors are used as inputs to train the each destination networks. The Algorithm is shown under results.

Analyzing the Result

The percentage of recognition is calculated as

$$\text{Percentage of recognition} = \frac{Numberof\ \ recognised\ envelope}{Total\ \ Number\ of\ \ test\ data}\times 100 \quad (7)$$

Percentage of unrecognized envelop is calculated as

$$\text{Percentage of recognition} = \frac{Numberof\ \ unrecognised\ envelope}{Total\ \ Number\ of\ \ test\ data}\times 100 \quad (8)$$

The ratio of the percentage recognized envelope and unrecognized envelope is taken to see how effective the developed system is.

The implementation of this project work has been done mostly using Matlab version 7.1 and the accompanying Image Processing Toolbox. MATLAB is a high level language for technical computing; it is a programming system with many mathematical methods implemented. It also has many toolboxes. The system supports procedural programming and has some object-oriented programming capabilities. A basic data structure is the array. MATLAB has many functions for processing arrays that are useful. Multidimensional arrays are supported. A 1-D array may be referred to as a vector. A 2-D array is referred to as a matrix. The terms array and matrix are sometimes used interchangeably. There are built in functions for performing standard matrix operations as described in linear algebra topics. An image would be a 2-D array or matrix in this notation. The matrix operations are often the most efficient ways to implement algorithms since they have been optimized. The system has another data structure called cell arrays where the elements are cells. A cell can hold other arrays of any size and type. It is a flexible and useful data structure. MATLAB has:

(i) Wide variety of modeling and pre-processing tools already available
(ii) Flexibility to create custom applications, as well as custom pre-processing
(iii) Open architecture, allows 4th party participation
(iv) Numerous standardization approaches
(v) Users in many different disciplines (helpful when "linking" analytical and dynamic systems)

Results and Discussion

Developed Algorithm for Implementation

1. Form network according to the specified topology parameters
2. Initialize weights with random values within the specified ±weight_bias value
3. load trainer set files (both input image and desired output text)
4. analyze input image and map all detected symbols into linear arrays
5. read desired output text from file and convert each character to a binary Unicode value to store separately
6. for each character :
7. calculate the output of the feed forward network
8. compare with the desired output corresponding to the symbol and compute error
9. back propagate error across each link to adjust the weights
10. move to the next character and repeat step 6 until all characters are visited
11. compute the average error of all characters
12. repeat steps 6 and 8 until the specified number of epochs
13. Is error threshold reached? If so abort iteration
14. If not continue iteration

Testing Algorithm

- load image file
- analyze image for character lines
- for each character line detect consecutive character symbols
- analyze and process symbol image to map into an input vector
- feed input vector to network and compute output
- convert the Unicode binary output to the corresponding character and render to a text box

Input data

- This consists of images of grey levels of size 2000 x 2000 pixels or more. Visual criteria and the information content of such mail pieces are briefly summarized in the following

- The address block to look for is composed of dark ink characters on a lighter background (either a white label or the gray colour of the envelope). Samples of processed envelopes are shown in Figure 7.

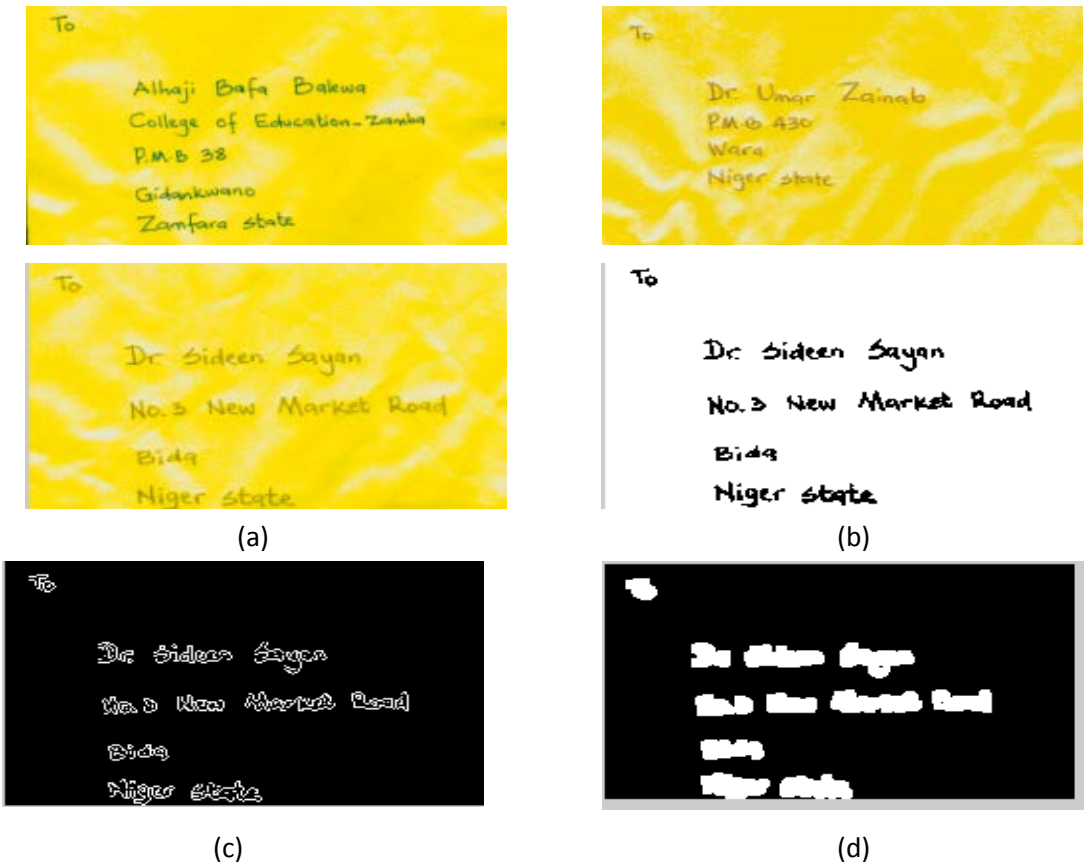

Figure 7: Samples of processed envelope

The group of pixel, the handwritten address on the envelope is removed from the background pixel. The segmentation uses black as foreground image and the background is white. The image binarization converts the scanned characters on the envelope to its binary form 0's and 1's.

- The format and size of the characters is arbitrary and cannot be established a-priori, especially for handwritten addresses. It is anyway smaller than other printed material present on the flat.
- The address lines do not have a fixed known direction, although typewritten text is mostly horizontal or vertical (unless for the free labels inserted into plastic envelopes).

Neural Network Parameters used in the Experiment

Number of hidden neurons = 1500
Number of epoch = 1514
Training algorithm = 'trainscg'
Transfer function used in hidden layer = 'tansig'
Transfer function used in output layer = 'logsig'

Table 1: Result analysis

Input data	Test Data	No of hidden layer	Recognized Envelope	% of Recognised envelope	Unrecognised Envelope	% of Recognised envelope
Kwara	I0	5	8	80	2	20
Lagos	30	6	27	90	3	10
Niger	15	7	14	93.33	1	6.67
Ogun	10	6	9	90	1	10
Oyo	10	5	8	80	2	20
Ekiti	15	3	10	66.67	5	33.33
Ondo	20	3	15	75	5	25
Gombe	10	8	10	100	0	0
Borno	20	5	17	85	3	15
Enugu	5	3	3	60	2	40
Benue	5	5	4	80	1	20
Kano	5	8	5	100	0	0
Jigawa	5	3	3	60	2	40
Bauchi	10	5	9	90	1	10

Result Evaluations

From the above result it is observed that the number of hidden neuron affects the recognition capability of the artificial neural network. The number of epoch also affects the recognition of the neural network. Therefore, to train a particular pattern large number of training data is required. A sample of the interface is shown in Figure 8.

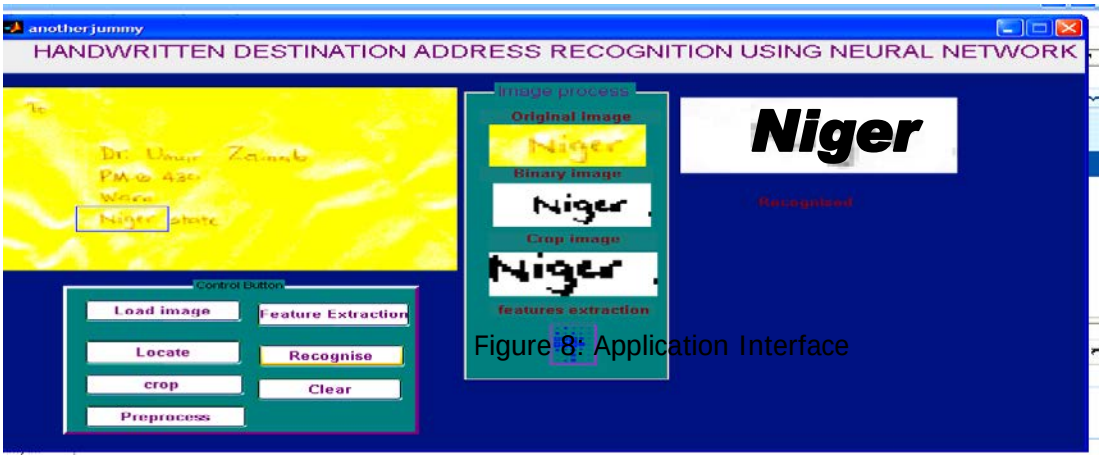

Figure 8: Application Interface

Conclusion

Using artificial Neural Network in character recognition is biological motivated and seems like an interesting approach not only to character recognition, but machine recognition in general as evidenced from the implementable algorithm discussed in this paper. Further research should be carried out on handwritten recognition to be able to recognized phrase recognition irrespective of whether the set of training data uses capital letter or small letters.

Recommendation

Further studies should be carried on in the aspect of handwritten word or phrase recognition system in order to increase the computer vision in the aspect of artificial Neural Network.

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THE SIMULATION OF PATH CONTROL AND ROUTE REDISTRIBUTION TECHNIQUES ON THE INTEGRATION OF WANs WITH DIFFERENT ROUTING PROTOCOLS

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Abstract
There are several other techniques that could be used to control paths in the integration of Wide Area Networks (WANs) with diverse routing protocols such as frame relay, enhanced interior gateway routing protocol (EIGRP), etc. In this paper, the concept of route redistribution was considered to integrate Wide Area Networks with different routing protocols. A simulation of networks with different routing protocols integrated as a single network to aid communication between them was developed with the help of a simulation package known as Cisco Packet Tracer. This simulation approach enables various users of the said network to distribute files, communicate and navigate across the entire network thereby managing and controlling paths. In conclusion, the use of route redistribution in the integration of WANs with different routing protocols had helped reduced some of the problems that aroused as a result of the integration of network with different routing protocols.

Keywords: Routing, Route Redistribution, Internet Protocol, Routing Protocols

Introduction
Pathing otherwise known as path control basically refers to tools and protocols used by layer 3 devices to learn, forward, manipulate and use IP routes in a WAN network. Path control has to do with controlling the path traffic follows in a network communication, some networks only have one path for traffic to follow but most networks have redundant links, path control specifies which path the network administrator wants traffic to follow. This is normally used in storage networks. The choice of path to be taken is affected by the routing protocols used in the network, for example, different administrative distances, metrics, and convergence times may result in different paths being selected (Key, Aveue & Massoulie 2006).

When we have different networks running on different routing protocols, getting the two networks to communicate becomes a problem, route redistribution allows routing protocols from one different network to be advertised into another network with a different routing protocol at least one redistribution point needs to exist between the two routing domains. This device will actually run both routing protocols. Recent studies have shown that enterprise networks are more difficult to manage due to that their routing structures usually consist of routing instances and multiple domains (Han Shakkotai, Srillkant & Towsley 2006). Routing instances are caused by network administrative policies to filter route, other causes of routing instances occur in case of company mergers and equipments of different vendors are used. The potential need for route redistribution exists when a route learned through one source of routing information, most typically one routing protocol, needs to be distributed into a second routing protocol domain (routing instance). For

example, two companies might merge, with one company using Enhanced Interior Gateway Routing Protocol (EIGRP) and the other using Open Shortest Path First (OSPF). The engineers could choose to immediately migrate away from OSPF to instead use EIGRP exclusively, but that migration would take time and potentially cause outages. Route redistribution allows those engineers to connect a couple of routers to both routing domains, and exchange routes between the two routing domains, with a minimal amount of configuration and with little disruption to the existing networks. (A routing protocol will be run on one routing instance i.e. OSPF will be run on one routing instance of one company, department etc and EIGRP will be run on the other).

Related Works

Balchunas (2007) revealed that, it is preferable to employ a single routing protocol in an internetwork environment, for simplicity and ease of management. Unfortunately, this is not always possible, making multi-protocol environments common. Route redistribution allows routes from one routing protocol to be advertised into another routing protocol.

According to Internetworking Technology Overview (1999) routing involves two basic activities: determination of optimal routing paths and the transport of packets through an internetwork. The transport of packets through an internetwork is relatively straightforward. Path determination, on the other hand, can be very complex. One protocol that addresses the task of path determination in today's networks is the Border Gateway Protocol (BGP). The BGP is an inter autonomous system routing protocol.

Key et al (2006) worked on flexible routing schemes mitigating some of the problems associated with uncertain traffic patterns and workloads by making the exact location of capacity less important: if there is available capacity, the routing scheme will find it. In this paper a combined multipath routing and congestion control architecture that can provide performance improvements to the end user and simplifies network dimensioning for operators is proposed. A flow-level model was described, which was able to handle streaming and file transfer traffic, with stochastic arrivals, and look at a fluid limit. A congestion controller and path selection algorithm that automatically balances traffic across the lowest cost paths was also described, and a suggestion to ways in which just two paths may be used, with a random selection policy. A notable feature of a multipath congestion controller is that it cannot be tuned to a single Round-Trip Time (RTT), hence it differs from standard TCP with respect to RTT bias. Also this work showed that under certain conditions the allocation of flows to paths is optimal and independent of the flow control algorithm used. Scalability of the architecture results from implementing the algorithms at end-systems (Le, Xie & Zhang 2007).

Han et al (2006) considered the problem of congestion-aware multi-path routing in the internet. Currently, Internet routing protocols select only a single path between a source and a destination. However, due to many policy routing decisions, single-path routing may limit the achievable throughput. In this paper, we envision a scenario where multi-path routing is enabled in the Internet to take advantage of path diversity. Using minimal congestion feedback signals from the routers, a class of algorithms is presented that can be implemented at the sources to stably and optimally split the flow between each source-destination pair. Then shows that the connection-level throughput region of such multi-path routing/congestion control algorithms that can be larger than that of single-path congestion control scheme.

Radunovic, Gkantidis, Gheorghiu & Rodriquez (2007), Designing high throughput wireless mesh networks is a challenge, and involves solving interrelated scheduling, routing, and interference problems. In this paper, we exploit the fundamental properties of broadcast medium and path diversity in wireless meshes to implement multipath routing between a source and destination pair.

Network coding was used for a given unicast source-destination flow to ease the scheduling problem, exploit diversity, and deal with unreliable transmissions. It was described that multipath-forwarding algorithms, show their performance benefits over existing proposals, using simulation, analysis, and a prototype implementation on a small test bed. Proposition of a rate scheduling protocol that relies on network coding was done, which gives over 30 % performance improvements for a realistic topology and can double the throughput in certain cases.

The internet is a best effort network, which means that packets are neither guaranteed to arrive at the intended destination at all, nor guaranteed to arrive at the destination in the order that they were sent (Le, 2007). This fundamental design feature of the internet has allowed it to scale well, because reliability is implemented at the end-hosts and not within the network. To provide applications with a guaranteed, in-order, data delivery service, a reliable transport protocol must operate over this unreliable network. Many of the most popular Internet applications, such as the web, file transfer, electronic mail, and remote terminals, rely on end-to-end reliability between hosts. Almost all of this traffic uses one dominant transport protocol; named the Transmission Control Protocol (TCP).

Materials and Method

The paths which a message takes from host or source to destination can be as simple as using a single cable to connect one computer to another or it could be as complex as a network that literally spans the globe. The physical elements or hardware of the network are devices and media are. Hardware is the visible components of the network such as a router, a switch, laptop, a PC, or the cabling used to connect the devices. Some components may not be so visible. In the case of wireless media, messages are transmitted through the air using invisible radio frequency or infrared waves.

Network Design

Network planning and design is an iterative process, encompassing topological design, network-synthesis, and network-realization, and is aimed at ensuring that a new network or service meets the needs of the subscriber and operator. This study is to design two separate networks with each running a routing protocol different from that of the other. One network will be running on OSPF while the other runs on EIGRP. Figure 1 below depicts the process involved in the design of this work.

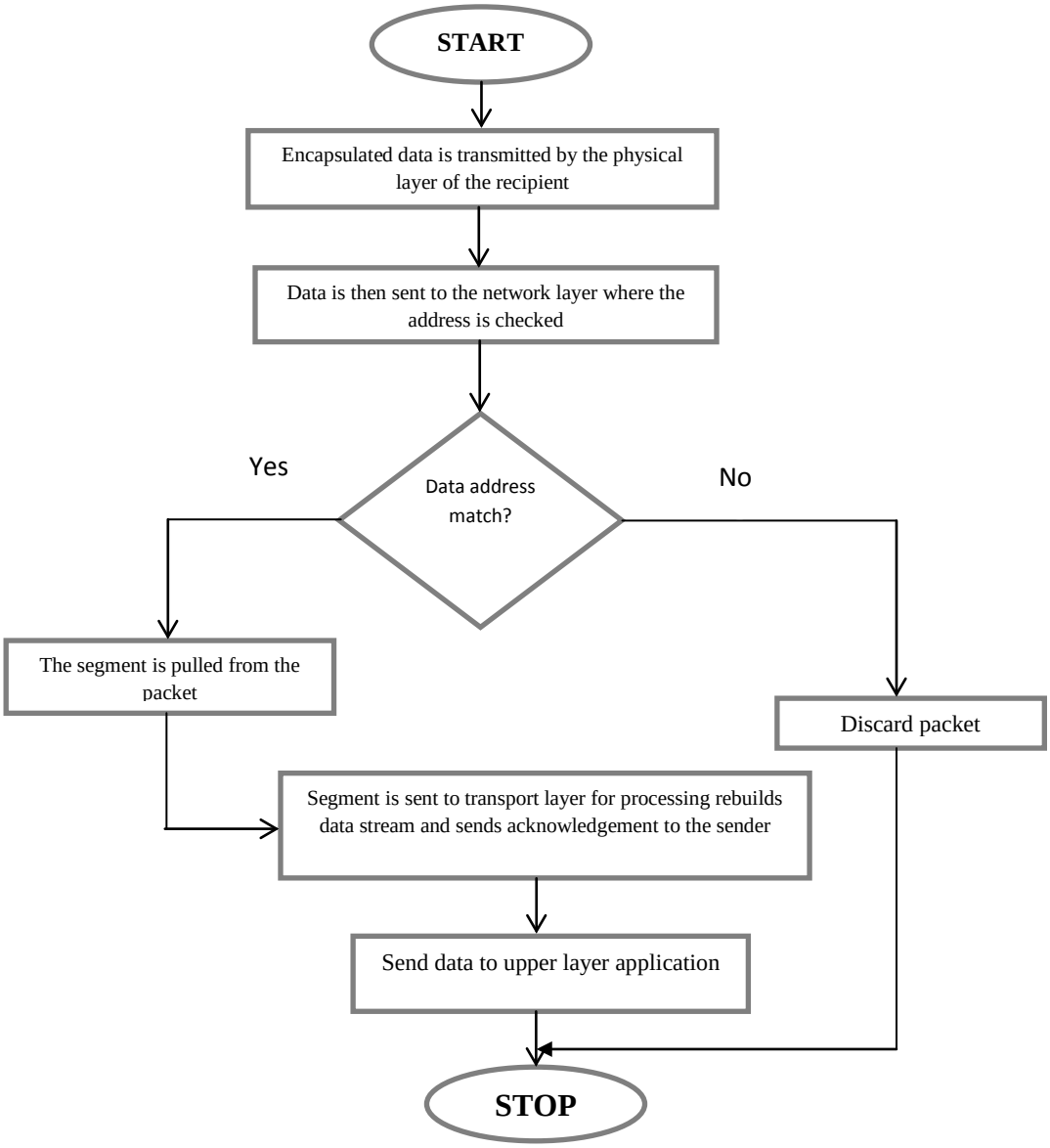

Figure 1: Flow chart representing data flow across a network

Open Shortest Path First (OSPF

Is a routing protocol developed for Internet Protocol (IP) networks by the interior gateway protocol (IGP) working group of the Internet Engineering Task Force (IETF). OSPF is a link-state routing protocol that operates by sending of link-state advertisements (LSAs) to all other routers within the same routing instance. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. As OSPF routers know and store link-state information, they use the SPF algorithm to calculate the shortest path to each node. The largest entity within the hierarchy is the autonomous system (AS), which is a collection of networks under a common administration that share a common routing strategy.

Enhanced Interior Gateway Routing Protocol (EIGRP)

According to Jumomo (2011), Enhanced Interior Gateway Routing Protocol (EIGRP) is an interior gateway protocol suited for many different topologies and media. In a well-designed network, EIGRP scales well and provides extremely quick convergence times with minimal network traffic. EIGRP is a Cisco proprietary routing protocol. EIGRP is a hybrid protocol as it incorporates features of a Distance Vector routing protocol and features of a Link State routing protocol. EIGRP is often used in Cisco-based networks running multiple network-layer protocols. EIGRP only advertises its entire routing table when it discovers a new neighbor and has formed an adjacency with it through the exchange of Hello packets. EIGRP routers will only advertise their routing tables to their neighbours.

Route Redistribution

Route Redistribution allows routes from one routing protocol to be advertised into another routing protocol. The routing protocol receiving these redistributed routes usually marks the routes as external. External routes are usually less preferred than locally-originated routes. At least a redistribution point is needed between the two routing domains. This redistribution point will actually run both protocols running on the interacting routes. Thus, to perform redistribution in the following example, the router at the middle would require at least one interface in both the EIGRP and the OSPF routing domains (Shafi'i M. A., Victor O. W. & Laminu I., 2011)

Simulation

The Cisco Packet Tracer is a powerful network simulation program that allows one to experiment with network behavior. Packet Tracer provides simulation, visualization, authoring, assessment, and collaboration capabilities and facilitates the teaching and learning of complex technology concepts.

Cisco Packet Tracer have two (2) workspaces; logical and physical workspace. The logical workspace allows users to build logical network topologies by placing, connecting, and clustering virtual network devices. The physical workspace provides a graphical physical dimension of the logical network, giving a sense of scale and placement in how network devices such as routers, switches, and hosts would look in a real environment. The physical view also provides geographic representations of networks, including multiple cities, buildings, and wiring closets.

The simulation of an effective path control network integrating wide area networks (WAN) running on different routing protocols was designed to be user friendly and easy to navigate using the Cisco packet tracer. The simulation was designed based on a topology known as the extended star topology. However, the components of the network were configured in other to ease transportation of packets from one end to another end successfully. The entire network was furthermore segmented into branch networks, having two branches or wide area networks (WAN's) being merged together by a merging router using the concept of route redistribution as discussed earlier. The first branch of the network had a router connecting to a mini-large local area network (LAN) which had switches and different end devices, and the router connecting the local area network on this branch was routing using EIGRP while the second branch is almost a duplicate of the other branch, only that the router connecting the local area network (LAN) is running on a different protocol OSPF. Finally the merging router came to play, using the concept of route redistribution to learn paths through which the two (2) branches will communicate across the network. A router was introduced named the merging router; this router connected the branches together to have a free flow of packets from different end of a branch to another, by configuring route redistribution on the router thereby enabling connectivity between the branches as shown in Figure 2 below, the branch network with yellow background is the branch running with EIGRP while the green background is running with OSPF protocols.

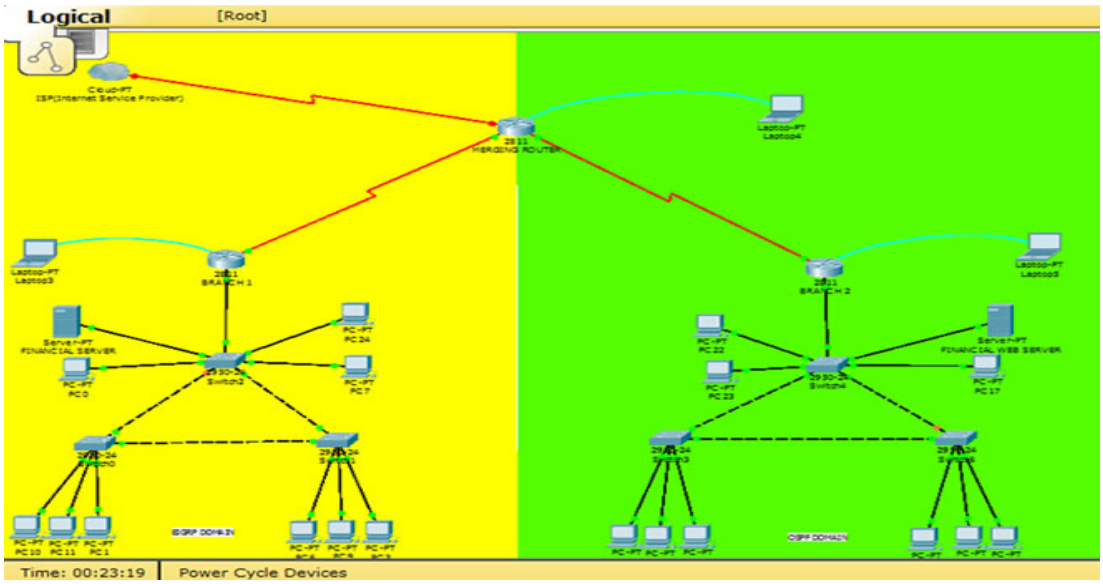

Figure 2: Screen shots showing entire network architecture using cisco packet tracer

System Testing

In order to examine the efficiency or how well the network was designed, tests are carried out using the ping packets to verify connectivity between the different segments of the network. Since the network has been segmented into two (2) branches with the merging router as a connector between the two (2) branches, then the connectivity test is carried out stage by stage.

Stage One

This stage comprises of the connectivity testing from one end device in a branch network to the router in the same branch, using the ping packets to ascertain whether or not connectivity exists in the network.

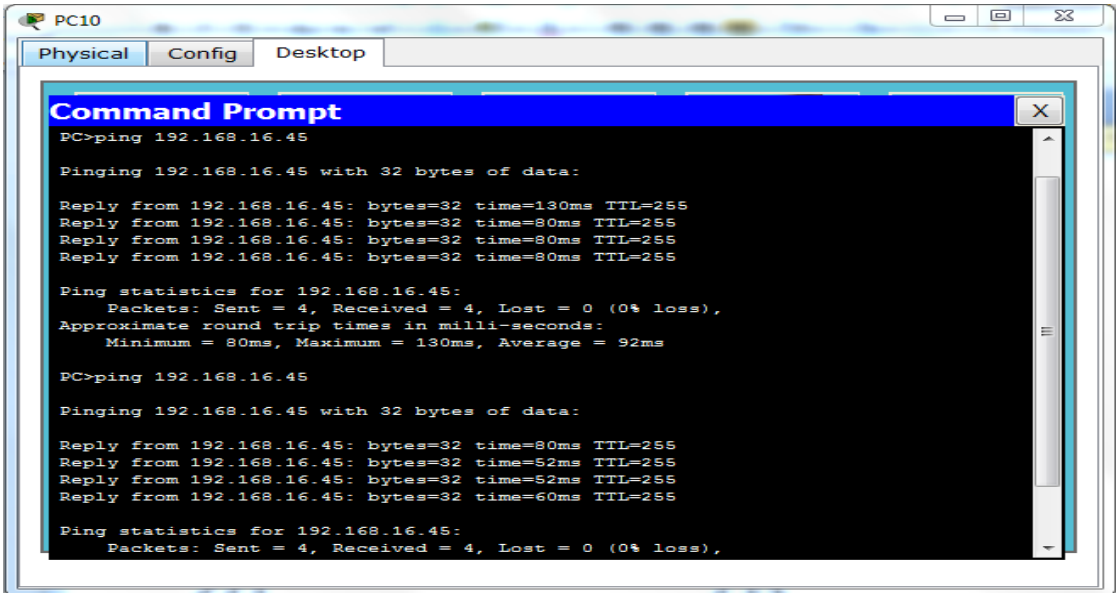

Figure 3: Screenshot Showing Connectivity Test from an End Device to a Router in

Branch 1 Network

From the figure 3 above, ping statistics for router with ip address (192.168.16.45)**;**
Packets: sent = 4, received = 4, loss = 0. Therefore since sent packets are received and there is no high percentage of packet loss, we conclude that connectivity exists in the LAN of the branch 1 network and exists even outside the LAN.

Stage two

At this stage of testing, test for connectivity between the router (router running on the EIGRP) of the branch1 network and the redistributed router (Merging router) i.e. the router that connects the two branches by learning the paths and routes. Using the ping packets to determine whether connectivity exists or not as shown in Figure 4.

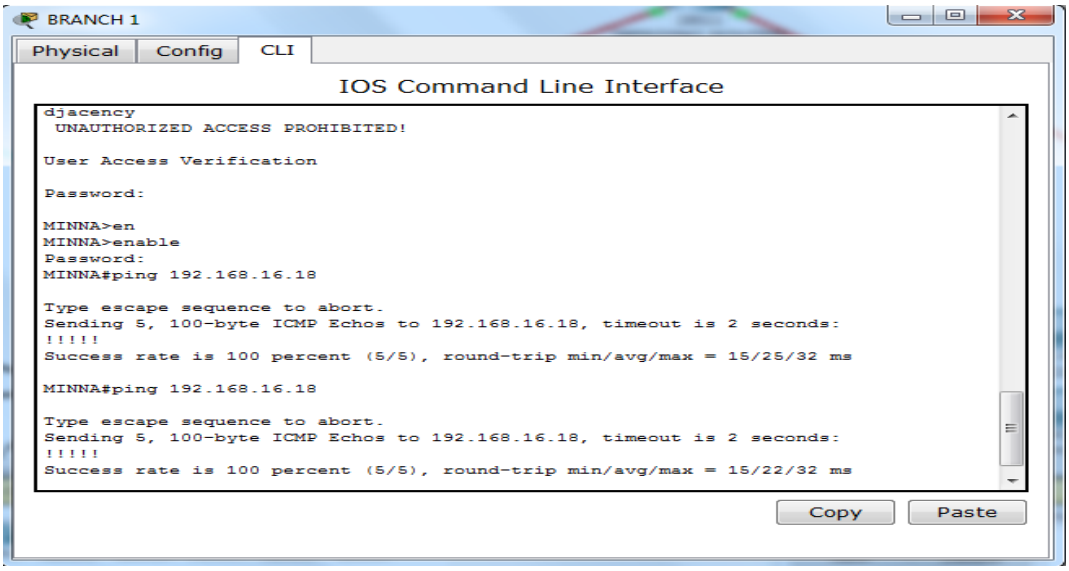

Figure 4: screenshot showing connectivity from branch1 router to merging router

ROUTER CONFIGURATIONS

Router(config)#hostname Minna
Minna(config)#banner motd x Unauthorized access prohibited! x
Minna(config)# line console 0
Minna (config-line)# password cisco
Minna(config-line)#login
Minna(config)#line vty 0 4
Minna(config-line)#password cisco
Minna(config-line)#login
Minna(config)#enable password cisco
Minna(config)#enable secret cisco
Minna(config)#int fastethernet 0/0
Minna(config-if)#ip address 192.168.16.45 255.255.255.240
Minna(config-if)#no shut
Minna(config)#int serialethernet 1/0
Minna(config-if)#ip address 192.168.16.17 255.255.255.240
Minna(config-if)#clock rate 64000
Minna(config-if)#no shut
Minna(config)#router eigrp 100
Minna(config-router)#network 192.168.16.16
Minna(config-router)#network 192.168.16.32
Minna(config-router)#no auto summary

The configurations above are the routers in figure 4 above, we can conclude that connectivity exists between the two routers, since there is a success rate of about 100% when packets are sent out of the router and are all received by the other router.

Stage Three

This testing stage was between the redistributed router (Merging router) and the router (router running on OSPF) of the branch two (2) network, test for connectivity was performed by using ping packets. The success rate is 100% thereby showing that the ping packets sent by the router were successfully received without loss in packets at a very good speed. Hence connectivity exists from the branch2 router to the merging router.

Stage Four

This stage of testing consists of the test for connectivity from the router (router running on OSPF) of branch2 to the end device in the LAN of the branch2 network, using the ping packets to verify and confirmed connectivity. The success rate is 100% which simply means the packets sent from the router was received successfully without loss in the packet, thereby proving that connectivity exists between the router and end devices in the LAN of branch2.

Stage Five

This stage comprises of the connectivity testing from one of the end devices in the branch1 network to an end device in the branch2 network, thereby trying to proof that the redistributed router has learnt all the paths/routes in the entire network.

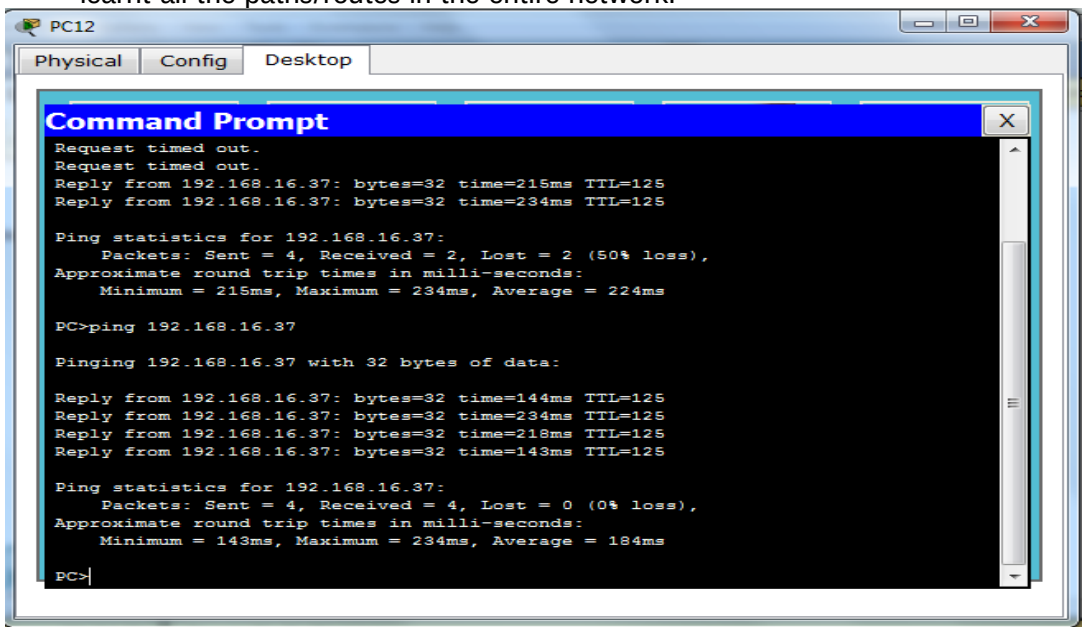

Figure 5: Screenshot Showing Connectivity from an End Device in Branch1 Network to an End Device in Branch2

From figure 5 above, ping statistics shows packets: sent = 4, received = 4, lost = 0 (0% loss), since there are no packet loss and packets were received, thereby showing that connectivity exists. Therefore it simply means that the redistributed router has learnt all the necessary route/paths in the entire network that is essential for connectivity across the entire network.

Stage Six

Finally the last testing stage is more like a security test, simply showing that authorized access cannot be granted to any other individual aside the network administrator to make effects on the routers or switches using the line console password and the enable secret password.

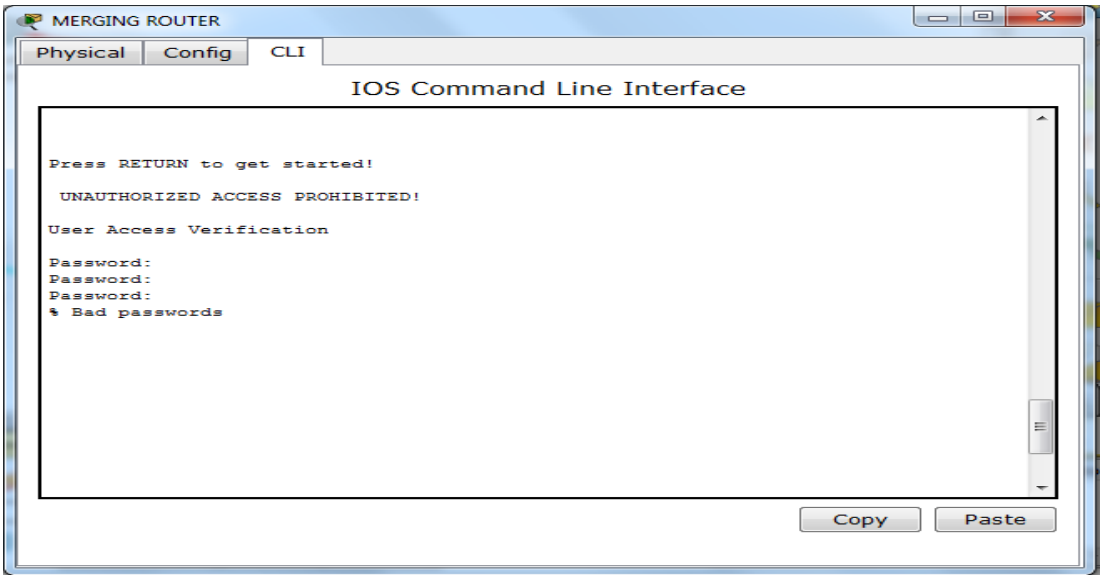

Figure 6: Screenshot showing the security of a router via the passwords

From figure 6 above, we discovered that the router is secured and cannot allow telnet i.e. remote access into the router or switches to alter configuration to sooth the individual. So without the console or telnet password unauthorized access is prohibited.

Discussion of Result

We were able to attain a great level of success in achieving the sole aim of this project work which is to simulate an integration of wide area networks routing on different routing protocols and also to efficiently manage and organize the paths or routes which packets or frames take to communicate across a wide area network.

The results ascertained from the system testing carried out using ping packets in the previous chapter, proved that wide area networks operating or rather routing on different routing protocols could be integrated using the basic concept of route redistribution against many other concepts and also solve the problems that arises when networks are being merged, especially problems like packet loss and security. From the screen shots of the simulation work, we could also say that about 100% efficiency level was obtained because all packets sent from one end of the network to another were all received thereby having a 0% packet loss and solving the problems of packet loss and packet interception due to lack of security.

Conclusion and Recommendations

In conclusion, integrating of wide area networks routing on different protocols using route redistribution concept had helped to reduce all the problems that made the needs for integration arise. For instance, when an organization grows very large and needs to merge networks of its various branches together to promote a healthy communication between its branches. All what the network administrator need to do is to have a remote router connecting the branches and he/she

manages and controls the network from their without having to visit the branch offices. This has also helped in the banking industry, such that wherever you are in the nation, your account details can be access without going to your particular branch and helped in so many areas that we didn't mention.

Network integration is essential in a large business environment, and ensures that the communication networks of an organization deliver the performance the business relies on. For effective communication of integrated networks, various concepts are applied to achieve a very high rate of success and a 0% packet loss. It's hereby recommended that:

- Emphasis should be made on the other concepts that could be used to achieve the integration of Wide Area Networks on different routing protocols.
- Route redistribution concept should be used as the most appropriate technique for the integration of Wide Area Networks on different protocols.
- The use of various routing protocols in a Wide Area Network should be supported, in other to enhance the security of the Network.

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ACUTE TOXICITY OF LINEAR ALKYLBENZENE SULPHONATE (LAS) DETERGENT TO *CLARIAS GARIEPINUS* FINGERLINGS

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Abstract
The lethal effects of Linear alkylbenzene sulphonate (LAS) detergent with trade name "ZIP" to Clarias gariepinus fingerlings was investigated using flow through and continuous aeration over a period of 96h. The LC_{50} of this toxicant was determined to be 23.99mg/L^{-1}. During the exposure period, the test fish exhibited some behavioural changes and later death. Some of the behavioural signs were loss of balance, restlessness, rapid swimming among others. Water quality measured during the experimental period showed high pH value which may be responsible for increase mortality at low concentration of the toxicant.

Key words: Lethal effect, *Clarias gariepinus,* alkylbenzene sulphonate (LAS).

Introduction

Pollution is defined as the deliberate or accidental contamination of the environment with wastes from human activities and such agents that cause pollution are called pollutants. They are substances which affect the quality of air (atmosphere), water and soil that destroys or perturbs biochemical cycles (linking people to animal and plants) and which damage the health of human (taking decades or generation to produce terminal disease).

Considerable amounts of detergent have been found to exist in the Nigerian freshwater system, where they generally affect several aquatic organisms, examples are *Oreochromis niloticus* and *Clarias gariepinus*. An understanding of the physiological response mechanisms of fish to all forms of adverse environmental pollutants and the effects of these additional stresses are to be assessed (Okwuosa and Osuaala, 1993).

The most harmful chemical substances can have an undesirable or distinctly harmful effect when taken up by an organism in sufficient amounts. No chemical is completely safe and no chemical is completely harmful (Lloyal, 1992). The factor which determines whether a chemical agent is particularly harmful or safe is the relationship between the concentration (quantity) and the duration of exposure. Poison is lethal when it causes death or sufficient to cause it by direct action and is sub – lethal when the poison is below the level that directly causes death but results in the regression of the physiological or behavioral process of the organism and its overall fitness is reduced (Okoli – Anunobi *et al*., 2002).

Fish is one of the most important non-targets organisms affected by detergent pollution. It is noted that lower levels would increase the uptake of other pollutant by the fish (Abel 1974). Effluents from industries wastes, Agricultural practices and also communal washing are common practice along several segments of rivers in Nigeria could lead to a build up of detergent level in natural waters causing oxygen depletion, reduction in water quality and damage to fishing interests.

Clarias gariepinus belong to the family Claridae and belonging to the genius Clarias. The family Clariidae has three genera and fifteen species are found in the Nigerian waters. The catfish family

clariidae comprises members of genus *chanallabes clarias, Heterobranchus, Gymnallabes* and *Heteroneusites*. *Clarias garipinus* is one of the most commonly cultured catfish in Nigeria. It is commonly found in open waters but it is most common in shallow marginal areas. This specie has high potential for culture because of its high fecundity rate, Omnivorous feeding habit, ability to grow and thrive well in adverse pond condition, good food conversion rate, and high palatability. Hence their importance in aquaculture.

Linear alkylbenzene sulphonate (LAS) detergent with trademark (klin) is a synthetic detergent which is widely used in so many textile industries which discharge their effluents into the aquatic environment. They are also used in washing clothes as well as for so many other domestic works. Okwuosa and Omeregie (1995) documented that synthetic detergents are toxic to fish at concentration between 0.4 and 40mg/l as obtained in Ofojekwu *et al*., (1999).

Materials and Method

Clarias gariepinus (5.0±1.2g) used as the test organisms for this experiment was collected from Jummic farm along Gidan Kwanu, Minna. The fish were transported to the Fish farm, Federal University of Technology, Minna in a portable well aerated polythene bag containing clean water. The fish were kept in indoor hatchery tank at temperature range of 25-26^{0}C for acclimatization for 2 weeks. During this period, the fish were fed with 40% protein diet in clean water.

The test concentrations of alkylbenzene sulphate detergent with trade name 'Klin' were prepared according to Donald and Philip (1987), by dissolving 100mg of the powder in 1 litre of distilled water. From the stock solution the following concentration were prepared alongside the principle of serial dilution method of Warner (1962); 10.00mg/l, 8.00mg/l, 6.00mg/l, 4.00mg/l, 2.00mg/l. Dechlorinated tap water formed the control at 0.00mg/l. Flow through system was used during the experimental period, 10 fish each were introduced into 12 glass aquaria of 33cm × 60cm × 20cm on the average, of 4mm thickness with over head tank (60cm × 50cm × 40cm) with water holding capacity of 200litres containing the different concentrations. Feeding was discontinued 24 hours before the commencement of the experiment through the experimental period. Mortality was recorded every 24 hours, though the aquaria were inspected every 3 hours for dead fish which were immediately removed. During exposure period, the temperature, dissolved oxygen, alkalinity and conductivity. Dissolved oxygen and alkalinity were monitored using the method of APHA, (1995). Conductivity was measured with conductivity meter while temperature was measure in situ with thermometer. The 96h LC_{50} was determined by graphical method.

Results and Discussions

Table 1: Mortality of *Clarias gariepinus* fingerlings exposed to different concentrations of LAS detergent for 96 hours.

Toxicant Conc (mgl^{-1})	log Conc (mgl^{-1})	Motality rate in duplicate 24hrs	48hrs	72hrs	96hrs	mean mort (%)	mean probit
10.00	1.00	1 0	1 0	0 0	0 0	10	3.72
8.00	0.90	0 2	2 0	3 0	0 0	35	3.96
6.00	0.78	3 0	0 0	0 0	0 0	15	4.61
4.00	0.60	1 0	3 0	4 0	2 1	55	5.13
2.00	0.30	0 5	3 0	0 1	2 0	55	5.13
0.00	0.00	0 0	0 0	0 0	0 0	0	-

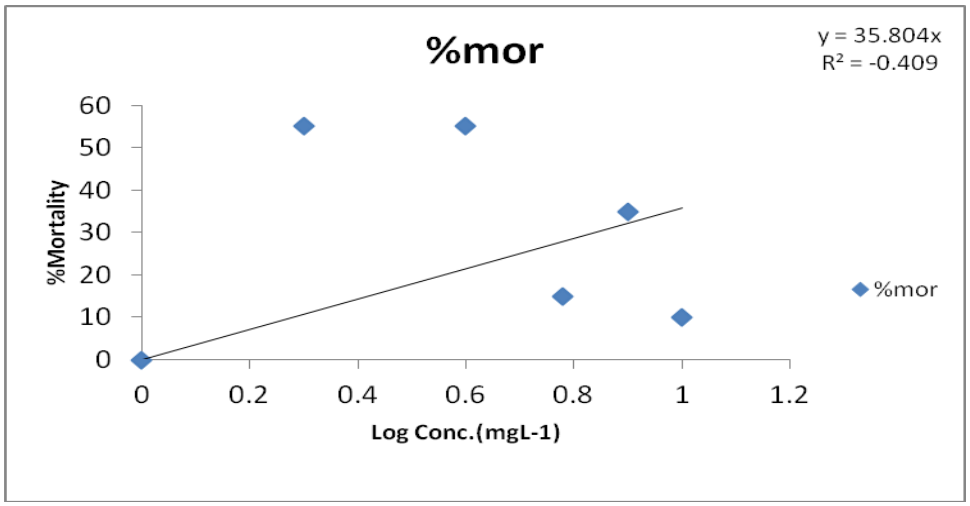

Fig 1: Graph of Clarias gariepinus exposed to different concentrations of LAS showing log concentration and mortality.

Table 2 : Mean mortality of *Clarias gariepinus* during the exposure period

	Concentration			
ln(mgl-1)	24hrs	48hrs	72hrs	96hrs
10	0.50	0.50	0.00	0.00
8	1.50	1.00	1.50	0.00
6	1.50	0.00	0.00	0.00
4	0.50	1.50	2.00	1.50
2	2.50	1.50	0.50	1.00
SEM	0.53333	0.4068	0.46667	0.26874
Significant	0.835	0.822	0.660	0.233

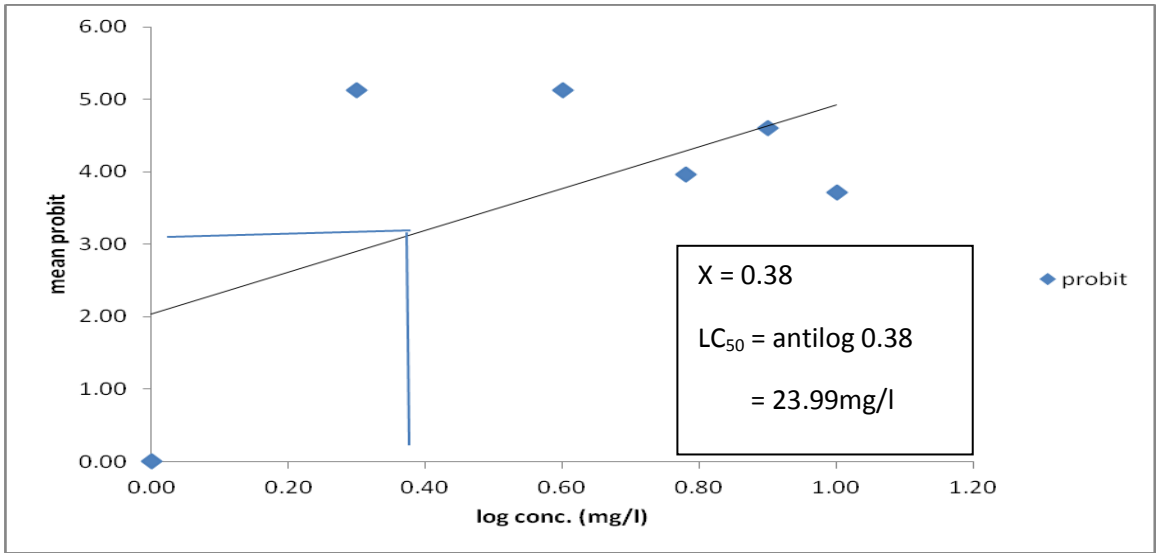

Figure 2: Determination of LC50 by graphical method Log_{10} conc. (mg/l) for *Clarias gariepinus*

Table 3: Water quality parameters recorded during the exposure of *Clarias gariepinus* fingerlings to different sublethal concentrations of linear Alkylbenzene sulphonate detergent for 96hrs

	Toxicant Concentration (mgll)				
Parameters	10.00	8.00	6.00	4.00	2.00
Disolved Oxygen (mgl^{-1})	6	6.8	8.2	6.8	4
p^H	7.40	7.40	7.40	7.40	7.40
Conductivity (μcm^{-1})	360	360	360	370	370
Temperature ($_0C$)	29.00	29.00	29.20	28.00	29.10
Alkalinity (unit)	110	180	112	114	90

Table 3 above showed the mean water quality parameters during exposure of *Clarias gariepinus* fingerlings to the detergent for 96hrs. The temperature, dissolved oxygen and conductivity concentration were observed to have remained relatively constant, whereas, the pH and alkalinity showed remarkable high concentration in table 3.

Swingle (1961) reported that the warm water fish of fresh water ecosystem are known to be most favoured by pH 6 and 8, and the acid and alkaline death points for fish are approximately pH 3 and 11 respectively.

Different behaviour patterns were exhibited by the test fish during the exposure period. Example, restlessness, rapid swimming, frequent attempts at jumping out of the tanks, rapid opercula movement, loss of balance, respiratory distress and excess mucus secretion towards the 96^{th} hour. The colour of the exposed fish became darker, the skin of the dead fish were dry and had lost their mucus lining. Haemorrhaging of the gill filaments were observed on the dead fish. These behavioural changes are indication of stress, nervous disorder and intoxication. These observations are similar to those of Omoregie *et al.*(1990); Ghatak and Konar (1991); Ufodike and Omoregie(1991); Okwuosa and Omoregie (1995); Nwanna *et al* (2003).

The lethal concentration that could kill half of the test population, LC_{50} , within the 96h test period (96h LC_{50}) obtained for the detergent was $23.99mg/L^{-1}$.

The mortality rate of the test fish exposed to various concentrations of the detergent as shown in Table 1 above revealed that the mortality was high at early concentration of the detergent. This could be due to the changes in the water quality parameters as a result of the detergent. There was no mortality in the control. The value of $23.99mg/L^{-1}$ as the 96hr LC50 for the detergent makes this toxicant highly lethal for fish in the aquatic medium. This figure is within the range of 0.4 - 40mgL-1 reported by Abel (1974) of synthetic detergents to be acutely toxic to fish.

Conclusively, alkylbenzene sulphonate detergent is toxic to *Clarias gariepinus* fingerlings. This detergent also contributes to pollution of the water which leads to the mortality of the fish.

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PROXIMATE COMPOSITION, FOOD AND FEEDING HABIT OF *HETEROTIS NILOTICUS* FROM RIVER KADUNA FLOOD PLAINS, NIGERIA

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Abstract
In order to evaluate the proximate composition and feed and feeding habit of Heterotis niloticus, a total of 144 H. niloticus specimen were collected from River Kaduna flood plains using the gill net. Moisture, crude protein, Lipid and ash were evaluated for proximate composition, while Frequency of occurrence; point method and dominance method were used to evaluate the feed and feeding habit. Sampling of the specimen was done fortnightly and variations in the percentage composition of the food items were recorded. It was observed that the fish fed mostly on plankton with rotifer and polycysits having the highest number of frequency and dominant value with mean value of 43.03±4.12 and 11.73±1.15, 37.45±3.27 and 8.32±0.38 respectively while Arcella had the least mean frequency of occurrence of 3.27±1.7, Amoeba sp had the least mean dominance value of 7.06±3.0, while Aphnocapsa sp had the least mean frequency of occurrence of 1.10±0.29 and Navasota sp had the least mean dominance value of 4.31±1.11. We can conclude from this investigation that H. niloticus fish is a semi fatty fish and the food and feeding analysis of H. niloticus from River Kaduna flooded plains are predominantly planktivorous.

Keyword: Dominance method; Frequency of occurrence method; Gut length; Proximate compostion

Introduction

The importance of fish in the economy and ecology of island water has generated a lot of interest. Over the years aquaculture has gained a rapid interest due to the importance of fish as a cheap source of animal protein, since beef is beyond the reach of the average Nigerian citizen

The importance of fish in developing countries has increased greatly. Foran et al, (2005) reported that fish is a highly proteinous food. Therefore, considering the nutritional benefits associated with fish consumption, it has become important that fish's mineral and proximate composition be assessed in order to establish the safety level of the table-sized species before consumption. The principal constituents most affected by the seasonal cycle changes are fat and moisture. The knowledge of proximate composition of fish species is important in the application of different technological processes (Huss, 1988) and as an aspect of quality of raw material, sensory attributes and storage stability (Sikorski *et al.*, 1990).

Moreover, the measurement of some proximate profiles such as protein contents, carbohydrates, lipids, moisture contents and ash percentage is often necessary to ensure that they meet the requirements of food regulations and commercial specifications (Watermann, 2000).

Fish like other animals require adequate nutrition to grow and survive. In the wild, nature offers a great diversity of food; these include nutrient in solution and a host of different plant and animals. However natural food is not sufficient to the fish culture especially in ponds, with high density of stockfish. Therefore in fish farming, for efficient and effective management to avoid high cost of production to produce fish at cheaper price there is need for proper and effective strategies, which can only be achieve via proper understanding of the food and feeding habit of the fish to be cultured.

The success of fishes in terms of their diversity and number is to a large extent the measure of their success in finding adequate food, sometimes in the most unlikely situations. The magnitude of fishes stocked in a region is a function of its food potentialities (Bhuiyan *et al.* 2006). Food is an important factor in the biology of fishes to the extent of governing their growth. Hence the study of the food and feeding habits of fish species is a subject of continuous research because it constitutes the basis for the development of a successful fisheries management programme on fish capture and culture (Oronsaye and Nakpodia, 2005).

The African bonytongue has been characterized as microphagous (Lowe-McConnell 1975;1987) and feeding on variable amounts of plant material, including seeds, and benthic and water column invertebrates (Lowe-McConnell 1975, Lauzanne 1976, Hickley and Bayley 1987). In contrast, bonytongues from other tropical regions are piscivorous (*Arapaima gigas*) or are generalized carnivores that feed on fishes and a variety of terrestrial vertebrates and invertebrates (*Osteoglossum* and *Scleropages spp*.) (Goulding 1980, Rainboth 1996, Allen *et al.* 2002).

Kaduna River rises or over flood its bank during the raining season, that is between May-September (Odekunle, 2004). Field investigations revealed that the flood plains have shown considerable effect on the population of plankton communities, which is as a result of nutrient of both allochthonous and anthodithonous materials concentration within the flood plains during the flooding and during the retreat of the floodwater.

However inspite of River Kaduna being richly blessed with a lot of commercially culturable fish species, little studies have been done on the relationship between basic morphometric measurement, growth pattern and food and feeding habits especially *Heterotis niloticus.* It is in this view that this research was carried out. The main objective of this research is to investigate the seasonal proximate composition, food and feeding habits of *Heterotis niloticus* from River Kaduna flood plain in Niger state of Nigeria through morphological features and stomach, body content analysis.

Materials and Methods

Sampling area

The Kaduna River is a major tributary of the Niger River, which took its source from Jos Plateau and flows in a northwesterly direction then southwards to join the Niger downstream of Wuya at Nupeko in Niger state. It covers a distance of about 575km and drains on area of about 66,300km^2 of diverse topography. The river is dammed at Shiroro also in Niger state about 348km down its course to form a reservoir with a surface area of about 312 km^2. The river is divided into two topographical zones. The upper zone; from its source to Zungeru town. This area is undulating with many rocky hills and rapids. While the lower zone starts downstream of Zungeru town to the confluence a distance of about 150 km (Odekunle, 2004)). This area is characterized by the presence of an extensive flood plain covering a total of about 150,000 hecter down the Niger.

Fish Sampling and Measurement

Specimens of *Heterotis niloticus* were collected fourthnightly from fishermen at three sampling sites namely Nku, Nupeko and Fokpo along river Kaduna flood plains from May 2006 – October 2006. Gill nets of mesh sizes ranging from 5-10 cm were the fishing gear used. Specimens collected were kept chilled in an ice chest to reduce post humous digestion of the stomach contents while in transit to the laboratory. At the laboratory total length (TL) was measured from the tip of the snout (mouth closed) to the extended tip of the caudal fin. Standard length (SL) was measured from the tip of the snout to the caudal peduncle, other basic morphemetric features; head length, snout length and eyes diameter were measured with the aid of a measuring board and a mathematic set divider. The lengths were taken with measuring board to the nearest 0.1 cm. Body weight of individual fish was measured to the nearest 0.1 g with an electric balance after removing the adhered water and other particles from the surface of body.

Proximate Composition Analyses

After preparation of edible parts of fish as described, proximate composition analyses were performed according to AOAC procedures (AOAC, 2000). Water content was determined by drying samples at 105±2°C until a constant weight was obtained. Dried samples were used for determination of crude fat, protein and Ash contents. Crude fat was measured by solvent extraction method in a soxhlet system where n-hexane was used as solvent. Crude protein content was calculated by using nitrogen content obtained by Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content (AOAC, 2000).

Stomach content analysis

The specimens were cut open and the stomachs were removed and immersed in 4% formalin. Each stomach was slit open, and the contents poured into a petri dish. The food were observed with unaided eye. Then, random samples of the stomach contents were taken and dropped on slides with the aid of a dropping pipette and observed under a light microscope. The stomach contents were identified and analyzed using the frequency of occurrence, point method and numerical methods (Bagenal, 1978). In the frequency of occurrence method, the number of stomachs containing each food item is expressed as a percentage of all non-empty stomachs, In the numerical method, the number of individuals in each food category is expressed as a percentage of the total individuals in all food categories.

Statistical analyses

Data were analyzed using one-way analysis of variance (ANOVA) using Statistical 6.0 (Stat-Soft, Inc., USA). Differences between treatments were compared by Tukey's test. Level of significance was tested at $P<0.05$.

Results

Morphology and anatomy of Heterotis niloticus in relation to its food and feeding

Heterotis niloticus of River Kaduna flooded plain has a terminal mouth. They have (4) four gills at each side of the body beneath the operculum. They also posses very long intestine ranging from 34-104 cm with an average length of 86 cm (Table 1). The gut of *H. niloticus* is differentiated into fore gut, the mid gut (bulging stomach) and the long intestine (hind gut). The rectum open into the anus from the fore gut to the end of the stomach is a very thick walled tube, which act as a gizzard the stomach is in side shape hence modified into grinding organ. This organ is more or less similar to the gizzard of chicken and other poultry**.**

Proximate Composition

Table the proximate composition of *H. niloticus* from R. Kaduna flood plain collected over a period of six months and the result showed that Lipid from the samples collected ranged from 5.01±0.58–

7.88±0.46% and was significantly highest in October and lowest in May (P<0.05). The Moisture and crude protein varied considerably over time in the samples, and ranged between 72.18±2.05-74.91±1.32 and 15.04±1.05-15.52±1.52% respectively and were significantly highest in May and lowest in October (P<0.05), however there was no significant different in the crude protein between the months of May-August in the sample (P>0.005). The Ash content ranged between 4.57±0.17-4.80±0.25 but there was no significant difference in the ash content of the samples throughout out whole period of the study (P>0.005).

Food analysis

Three conventional methods were used to evaluate the food content in the gut of the specimens Table 3and 4 give a summary of dominance and frequency of occurrence.

Frequency of occurrence

From Tables 3 and 4 the stomach content analysis showed wide variety of items. *Polycystic* had the highest value of frequency of occurrence followed by *chlorella* and *trochiscia* while the least frequency of occurrence phytoplankton are *gloecaystis, ophiocytium*. *Rotifers* had the highest value of frequency of occurrence with Amoeba *frontina, diaptomus* having the least occurrence among the zooplankton that was found in their stomach.

Dominance method

Tables 3 and 4 showed that the first stomachs were mostly dominated by phytoplankton by *polycystic, oocystyis trochicia* and *chlorella* while *rhozosolenia* and c*yelsppcrium* were the least dominant. The Zooplankton analysis observed showed that Rotifer and volvox dominated the stomach of *H. niloticus* while *frontina* Amoeba and Arcella were least dominate.

Point method

It was noted or observed that no fish stomach was completely empty; 34% were half full stomach and 66% were full.

Discussion

The proximate composition of *H. niloticus* varies considerably between May- October. According to Stansby 1985 variation in proximate composition of fish flesh may vary with species variation, season, age and feeding habit of fish. The result of the present study shows that the crude protein of *H. niloticus* was moderately high and declined gradually from May-October. The relatively moderate percentage crude protein in *H. niloticus* could be attributed to the fact that; fishes are good source of pure protein, but the differences observed, in the obtained values may also be attributed to fish's consumption or absorption capability and conversion potentials of essential nutrients from their diet and availability of feed during the experimental period or their local environment into such biochemical attributes needed by the organisms body (Adewoye and Omotosho, 1997). From this study variation in water and Lipid content of the samples indicated that while there was a decline in water content, fat content evidently increased, this is inline with the previous works reported on freshwater fisheries by Sadiku *et al* 1991. Huss 1995; Love, 1997 also reported that Fat content has shown inverse proportionality to water content in some semi fatty fish species muscle, this may be attributed to the seasonal differences in availability of food and changes in the reproductive cycle having considerable effect on the tissue biochemistry of the fish particularly changes in the lipid and water content of there body system. The range for the ash content gave an indication that the fish samples may be good sources of minerals such as calcium, potassium, zinc iron and magnesium.

From the shape of the mouth and the gills arrangement *H. niloticus* exhibited filter feeding with the aid of its fine gill rakers hence capable of filtering phytoplankton and zooplanktons. However, this

species is more of plankton feeder as earlier suggested or describe by Reed *et al* (1967), Olaosebikan and Raji (1998), Monentcham *et al.* (2009). They also reported that fishes with terminal mouth either prey upon other fishes or filter plankton from water, while Welcome (1967) reported that gills enable such species with this type of gills to feed on planktons. Reeds (1967) observed that fishes with numerous and fine gill rakers are either microphages or plankton feeders. The gut type is that of the omnivore, as reported by Larger (1977) he described the stomach of an omnivore as a food grinder. It was observed that smaller specimen had short gut length and weight in relation to the body length, however the gut length and weight shows that the gut is very long which range from 34-104 cm. This suggests a long gut transit time from the food of this fish. 45% of the specimens observed, have more food in the stomach (mid gut) than the hindgut. It was also observed that smaller specimens had short gut length and weight but in relation to the body weight. Fishes develop morphological and behavioral adaptations that allow efficient ingestion, digestion, and assimilation of organic matter in detritus (Bowen, 1983). The gizzard-like (muscular, thick-walled pyloric stomach) and pyloric caecae (blind pouches) of the gut of *H. niloticus* are examples of such adaptations (Moreau 1982) that are usually exhibited by advanced omnivores.

In term of individual food items the fish prefers plants materials (phytoplankton) favored by plant grains as earlier reported by Reed *et al* (1967), though *H. niloticus* of river Kaduna flood plains do not feed on detritus, they feed on polycystic suggesting a mid-water-feeding habit than bottom were they dwell. This may also be associated to the habitat of *Heterotis niloticus* where they mostly live in glassy areas where there is a lot of grass, particularly during the breeding season as they make their nest on grasses Bard *et al* (1976).

Frequency of occurrence of food analysis showed that polycystic were the predominant food items in period of phytoplankton boom during which there was a poor zooplankton community during this period polycystic oocystis trochiscia and chlorella were dominant food items in the guts being the dominant phytoplankton in the river and the filter feeding mechanism of the fish is non selective. At certain time of the year when zooplankton community increased with more of rotifer, the fish then had preferences for the rotifers and volvox as revealed by dominance method as earlier reported. Although throughout the experiment there was no decline in phytoplankton consumption but the intake of zooplankton increase tremendously after the algae boom during the raining season and towards the end of the raining season.

Conclusion

The results suggest that the proximate composition of fish species greatly varies during the catching season. This might be due to physiological reasons and changes in environmental conditions, i.e., spawning and starvation or heavy feeding. The physiological state of *H. niloticus* species in this study might greatly affect the proximate composition. This study provides valuable information on variations in proximate composition of fish species studied in order to take necessary precautions in processing from a manufacturer point of view and to distinguish their nutritional value and make a choice based on that information from a consumer point of view.

The food and feeding habit study of the *H. niloticus* showed that the fish prefers food items that varies with time during the four months period of this study there was preference of *polycystic sp* before rotifers succeeded later.

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Table 1: Summary of biometrics measurement, gut length and gut weight measurements of *H. niloticus* sample

Measurement	Range (cm)	Mean value
Total length (cm)	24.3 - 49.4	22.9±2.04
Standard length (cm)	20.2 - 45.0	27.7±5.0
Body weight (g)	140.0 - 900.0	265.2±145.8
Gut length (cm)	35.0 -104.0	48.8±10.6
Gut weight (g)	3.1 -32.4	6.6±4.3

Table 2: Summary of Proximate composition of *H. niloticus* sample

Months	Moisture (%)	Lipid (%)	Protein (%)	Ash (%)
May	74.91±1.32^{e}	5.01±0.58^{a}	15.52±1.57^{b}	4.54±0.17
Jun	74.52±2.53^{d}	5.22±0.33^{b}	15.46±0.56^{b}	4.66±0.22
Jul	73.59±2.16^{c}	5.51±0.41^{b}	15.48±1.32^{b}	4.71±0.55
Aug	72.91±1.07^{b}	5.89±0.34^{c}	15.47±0.78^{b}	4.73±0.43
Sept	72.65±1.13^{b}	6.61±0.76^{d}	15.26±1.12^{ab}	4.76±0.56
Oct	72.18±2.05^{a}	7.88±0.46^{e}	15.04±1.05^{a}	4.80±0.25

***Values in the same column with different superscript letters are significantly different (P<0.05) from each other.**

Table 3: Summary food evaluation in *Heterotis niloticus* zooplankton

Food items	Frequency of occurrence	Percentage Dominance
Cypriclopsis	4.88±1.05^{a}	8.74±0.81^{a}
Eubranchipus	4.27±1.83^{a}	8.33±1.98^{a}
Diatomus	3.84±0.37^{a}	8.39±0.63^{a}
Frontinia	4.40±1.21^{a}	8.92±0.66^{a}
Amoeba	3.37±0.82^{a}	7.06±0.50^{a}
Chilodon	5.16±1.30^{b}	8.61±1.15^{a}
Holophaya	4.14±0.56^{a}	8.91±0.88^{a}
Colpodium	3.34±0.65^{a}	8.89±2.07^{a}
Arcella	3.27±1.70^{a}	8.60±0.97^{a}
Volvox	20.16±4.38^{b}	11.76±1.15^{b}
Rotifer	43.03±4.12^{c}	11.76±1.15^{b}

***Values in the same column with different superscript letters are significantly different (P<0.05) from each other.**

Table 4: Summary food evaluation in *Heterotis niloticus* phytoplankton

Food items	Frequency of occurrence	Percentage Dominance
Gloecocystis	2.52±1.45^{a}	5.97±1.35^{b}
Ophiocytium	2.00±0.49^{a}	6.38±0.62^{b}
Chlorella	16.84±3.09^{c}	8.32±0.38^{c}
Trochiscia	18.27±2.70^{c}	8.32±0.38^{c}
Sceneolesmus	1.25±0.32^{a}	4.52±0.95^{ab}
Oocystis	8.30±4.01^{b}	8.32±0.38^{c}
Surivella	1.38±0.36^{a}	4.98±1.32^{ab}
Gomphpnema	1.24±0.42^{a}	4.89±1.63^{ab}
Stephanodiscus	1.36±0.19^{a}	5.69±1.62^{ab}
Cicconesis	1.17±0.41^{a}	4.95±1.20^{ab}
Rhizosolenia	1.21±0.37^{a}	4.31±1.11^{a}
Navicula	1.53±0.67^{a}	5.16±0.89^{ab}
Cyclotella	1.48±0.71^{a}	4.49±0.55^{a}
Coelosphaerium	1.10±0.27^{a}	4.46±0.82^{a}
Aphnocapsa	1.37±0.50^{a}	5.58±1.14^{ab}
Polycytis	37.45±3.27^{d}	8.32±0.38^{c}
Phormidium	1.67±0.54^{a}	5.58±0.34^{ab}

***Values in the same column with different superscript letters are significantly different (P<0.05) from each other.**

RENT STRUCTURE OF RESIDENTIAL PROPERTY: DO THE QUALITY OF INTERNAL AESTHETICS REALLY COUNT?

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Abstract
This study attempts to examine the rent structure of residential properties (tenements,bungalows and flats) vis-à-vis their variance across six different neighbourhoods in Minna, Niger State using descriptive statistics and Analysis of Variance test. Secondly by its exploratory nature, 290 samples of residential properties were drawn to determine the types and quality (using multi-dimensional scaling) of their internal aesthetic and the impact of such quality on rent variance within the study area. An interesting result of this study is that aside Sabon –Gari, a inner-core neighbourhood, variability in rent distribution is greatest for properties in F-Layout with such variability decreases with increasing distance from the inner part of Minna where F-Layout is located to further away locations such as Bosso Estate, Dutsen Kura Hausa, Tudun Fulani and Okada road. Within this purview, internal aesthetics account for 16.7% of the total variation in residential rents in the study area. As such property owners and real estate investors must rise to the challenge of improving the quality of internal aesthetics of dwellings especially in Sabon-gari, Tudufulani and Dutsen-Kura to be at parity with other neighbourhoods. This is against the backdrop that the rental price of a house depends of the utility and satisfaction embodied and derived from such aesthetics and these are differently priced by tenants.

Key words: Aesthetics, Rent, Residential, Property, Quality

Introduction

Unlike other asset class, real property and by extension residential property is highly differentiated, physically modifiable and a durable commodity. These characteristics depict that the market for residential property presents a somewhat peculiar complexity which makes long run equilibrium within the market elusive. Slow adjustments or lags resulting from the long durable nature of dwelling stock as well as other complications on the supply and demand sides ensure that the residential property market hardly adjust to exogenous changes (Dehesh and Pugh, 1995; Watkins, 2001). Despite these slow adjustments and other featured fluctuations (such as information asymmetric problem and changing financial cost of moving) rent has however remained a significant feature of most markets for housing services in the world as the interaction of the demand by residential property users with the current stock of space made available by the landlords predict the pattern of rents.

From the residential property market view point, the race for space would eventually culminate in cost (rental value) which must be borne by the space users and paid to property owners. Perhaps more than the property owners, space or property users are bound to generate considerable interest in rental price trends and link them back to some explicative factors. This is against the backdrop that rental value cyclicality have far-reaching implications on consumers' spending and saving pattern and also create self- reinforcing and dampening effects on demand and supply of housing itself (Stein, 1995; Ortalo- Magne and Rady 2004 and Sing *et al.*, 2006).

Aptly it has been stated by Worzala and Bernasek (1996) that the value of most real estate is derived from local market conditions impacting on the demand and supply and hence value. One of such peculiar local market conditions is the type of housing services or utility provided such as internal aesthetics, which depends on the configuration, structural and constructional attributes of the housing units which is hitherto influenced by household types and their particular needs. The primary objective of this paper is to examine the rent structure and variance within the Minna residential property market with the intent to determine the extent to which the attributive internal aesthetic quality of residential properties present within the study area impact on residential rents.

Determinants of Rent

Rent has been widely acknowledged as the cost borne as a result of the demand for space by the tenant for a specified period of time. Within the rental market the interaction between the residential property users and the current stock of space made available by the landlords predicts the pattern of rents and the level of occupancy, with vacancy clearing the market (Keogh 1994 and Geltner *et al.,* 2007). Geltner et al. (2007) further observe that rent itself gives a signal about the current value of the built space and the current balance of supply and demand for that space.

Theories of urban dynamics are deeply rooted in households and consumers utility. Urban location models such as the access-space model formulated by Williams Alonso in 1964 and later built upon by Richards Muth in 1969 for the analysis of urban land and property markets posits location as determining factor in household residential choice decisions (Goodman and Thibodeau, 1998). For example, the residential bid rent theory posits that, housing and accessibility to locations are jointly purchased and that it is only abstracting location specific amenities; that households would lower their bid price for housing as commuting cost increases. Location as the important feature of a property is a truism as it is key driver of real estate activities and values. In the context of residential properties, prime locations are not only determined by proximity to schools, CBD and public transportation but also by other externalities (Boyle and Kiel; 2001 and Bourassa et al. 2005).

Empirical studies by Evan (1995) and Watkins (2001) have however revealed a lukewarm support for the assumptions of some of these classical theories. They counter argue that, rather than the choice of residence, its rent and price being based on only location, they should be based on other attributes including location. This as Redfearn (2009) observes is partly due to the fact that residential property is a differentiated good which cannot be unbundled and repackaged such as to allow end users to buy and consume some selected set of housing traits at any desired location and partly because cities are distorted to the extent that residential prices and rents are influenced by employment centres, irregular sparse spatial amenities, disamenities and by neighbourhood idiosyncrasies.

Buyers and renters within the property market compete for dwelling units made available to them in the bidding process, with such dwellings made up of packages of structural, location factors and neighbourhood traits. It is these packages that determine rent and dwelling price (Adair *et al*. 1996; Basu and Thibodeau, 1998; Tse 2002; Bourassa et al.2007; and Paez, *et al.* 2008). Typical examples of structural characteristics include gross floor area, number and area of bathrooms, and bedrooms and type and quality of internal and external aesthetics. With respect to location and neighbourhood factors, Galster (2003) mention that, ‘‘it does not mean that they are intrinsically coupled with the geography - some are physical environment (presence of scenery and neighbourhood image) others are related with individuals who lend their collective attributes to the space through aggregation (for example income and race)’’. These are both externalities which impact on rent and price.

To this end, the connection between these housing characteristics (structural, location and neighbourhood factors) and housing prices merit consideration. Studies by Allen *et al.* (1995) and Watkins (1999) reveal that tenants tend to limit their choice to specific property type regardless of location. Comprehensively, Maclennan and Tu (1996), Adair *et al.* (1996); Yates and Mackay (2006) findings suggest that, added to structural factors, spatial features are important housing price determinant, consequent upon the inelasticity of demand and short run supply over a given time frame. Suffice to say however that the issue whether structural characteristics are more important than locational effects in the process of housing price determination is still debatable as empirical research have suggested.

The focus of this paper is not the merits of any one factor over the other. Allen *et al.* (1995) and Watkins (1999) studies can be extended by focusing on an integral component of structural characteristics of a dwelling which is its internal aesthetics. In doing this it can be established that the structure of residential rents and subsequently determine if such structure and its variance is best explained by variance in aesthetic attributes of dwellings in Minna, Niger State.

Hypothesis of the Study

In passing, two major hypotheses (which are non-directional, leading to two- tail test) were set to achieve the primary objective of this study:

Hypothesis I:

Null Hypothesis (H_0): Variation in rents across the six neighbourhoods in Minna is statistically equal.zero ($H_0 = 0$).

Alternative Hypothesis (H_1): Rent variance across the six neighbourhoods in Minna is not equal to zero. ($H_0 \neq 0$).

Hypothesis II:

Null Hypothesis (H_0): There is no significant relationship between residential rents and internal aesthetic attributes of dwelling. ($H_0 = 0$).

Alternative Hypothesis (H_1): There is significant relationship between residential rents and internal aesthetic attributes of dwelling. ($H_0 \neq 0$).

Research Methodology

The data for this research is from six (6) of selected neighbourhoods (F-layout, Tudun Fulani, Dusenkura Gwari, Bosso Estate, Okada Road, Sabon Gari,) in Minna Niger State of Nigeria (Fig.1). In the figure, Okada Road is located between Dutsen Kura and GRA. The choice of the selected neighbourhoods is based on the heterogeneous nature of Minna in which its urban area comprising 25 neighbourhoods is segmented into transition, core and peripheral. By employing stratified random sampling, we selected 1 neighbourhood from the inner area (F-Layout,); 4 from the outer area (Tudun Fulani, Bosso Estate, Okada Road and Dusenkura Hausa) and 1 from the core area (Sabon Gari).

Basically, two (2) sets of data were collected from the study area. The first set includes the structural characteristics of the internal aesthetics of residential properties in the case study area. Five (5) variables which are surrogate for the type and quality of internal aesthetics of dwellings include: the types and condition of floors, internal walls, doors, ceilings and windows. The second set is the collection of residential property rents from properties for which corresponding data on

their internal aesthetics have been collected. We extracted these two sets of data from closed item questionnaires administered on residents who are tenants in tenements, bungalows and flats within the selected neighborhoods in the study area as at 2011.

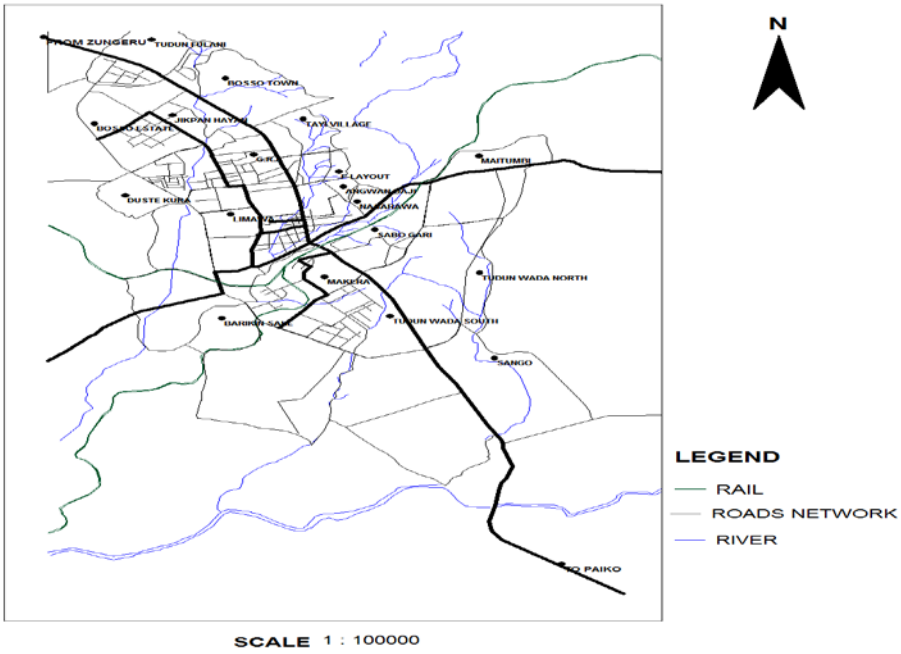

Fig. 1: The selected neighbourhoods in Minna

For this research, the tenants responded to 410 questionnaires of which 120 questionnaires were discarded due to missing and incomplete information especially on rent. As such the sample size for this study is 290 while the sampling ratio and interval are 0.73 and 1.37 respectively.

Taking a cue from handful of authors (Galster and Hesser 1981; Bonaiuto *et al.* 1999 and Ame´rigo 2002) who have used multi-dimensional scaling (such as Likert and semantic differential) to develop a general model of housing quality that places user goals at the center of the evaluation of the residential environment, we focus on the perception of the residents using five (5) point Likert scaling to uncover the underlying dimension of the quality of the aesthetics in the study area. This entails residents ascribing scores (ranging from 1 to 5 to a continuum of responses on strongly disagree, disagree, undecided, agree and strongly agree) to each of the 5 aesthetic variables based on their perception in order to control for quality (for instance, based on quality and price, floor tiles tend to have higher premium and would be ranked and scored as such than concrete floor). The sum scores of aesthetic variables were then weighted for each property so as to arrive at the composite mean internal aesthetic quality score for each property and subsequently the aggregate mean score of internal aesthetic quality for each neighborhood. For comparison of internal aesthetic quality across the neighbourhoods in study area, we classify the quality of the aesthetics based on a subjective scaling cut-off (2.80-2.90 indicate poor quality of internal aesthetics; 2.91- 3.09 depict fair quality; while >3.10 is good quality).

For the purpose of analysis, the data were subjected to statistical techniques which set the stage for interpreting data and reaching conclusions in this subsequent section that followed. First Analysis of Variance a univariate analysis was used in order to assess the level of variance in rental values in

the study area. The fundamental procedure in ANOVA is to determine two separate population estimates (between and within group variance) from the rental value data collected from the 6 selected neighborhoods in the study area. Then an F-statistic is calculated from the ratio of the two estimates. A significant F-statsitic implies that the mean populations of the rental value of residential properties within the neighborhood are not equal.
Subsequently, Levene's test as usual with analysis of variance was conducted on the residential rents in the 6 selected locations in the study area vis-a-vis Tukey's Honestly Significant Different (HSD) post- hoc test and homogenous subsets of the variables to determine where the significant effect lies. The final result is presented in the analysis of variance model and the post-hoc analysis of the multiple comparisons of the independent variables based on mean difference in subsequent section.

Secondly, we employed multiple regression model to show the extent to which interior aesthetics (predictor variables) predict or account for variation in residential property rent(the dependent or criterion variable) in the study area. The model further reveals the internal aesthetic variables which are important determinants of residential rents in the study area at 5% level of significance. In constructing a parsimonious model we establish if some of the assumptions of the classical regression model (uncorrelated residual term and multicollinearity of the regressors) have been violated. In passing we check for serial correlation in the residual term using the Durbin-Watson test. By following Johnston and DiNardo (1997), the Durbin-Watson statistics must be close to 2.00 to suggest that there is no serial correlation in the residuals of the estimated regression equation. The Tolerance and Variance Inflation Factors (VIFs) test for multicollinearity among the independent variables (Maddala 1992). As a rule of thumb, if the VIF of a variable exceed 10 or if its Tolerance is closer to zero, multicollinearity may be a problem (Gujarati 2003). The empirical results are presented next.

Structure of Residential Rent in the Study Area

Table 1 Summarily presents five parameters related to the structure of residential rent by neighbourhoods in the study area

Table 1: Rent structure of residential properties by neighbourhoods in the study area

Neighbourhood	N	Mean	Std. Deviation	Coefficient of Variation	*Minimum Value	*Maximum Value
Bosso Estate	75	126533	59286	46.85	20000	250000
Dutsenkura Hausa	46	87622	48840	55.74	18000	200000
Flayout	31	95161	137110	144.08	20000	280000
Okada Road	60	127417	60032	47.11	30000	250000
Sabon Gari	22	66818	30920	46.28	20000	120000
Tudu Fulani	56	97946	51573	52.65	20000	200000
Total	290					

* The minimum and maximum values signify that the minimum rents are for tenements; while the maximum in most cases are rents for flats and bungalows.

From in Table 1, Okada road had the highest mean residential rent of ₦ 127417 followed by Bosso Estate with an average rent of ₦126533. Seemingly, rents in F-layout (₦ 95161) and Tudu Fulani (₦ 97946) are within the same region. While Sabongari (₦ 66818) has the lowest mean rental value. Secondly, for all the sampled properties, the statistical variability relative to the mean residential

rent as indicated by the coefficient of variation is lowest in Sabongari neighbourhood; implying highest level of homogeneity in residential rent.
Thirdly, variability in rent distribution is greatest for properties in F-Layout with the variability decreasing with increasing distance from the inner part of Minna where F-Layout is located to further away locations such as Bosso Estate, Dutsen Kura Hausa, Tudun Fulani and Okada road.

However, rather than rely solely on descriptive statistics as reported in Table 1, there is need to employ higher level statistics to provide statistical explanations on the extent of variance in the structure of residential rents in the study area as follows.

Analysis of Variance in Rents

In Table 2 the null hypothesis of homogeneous population variance in the residential rents is rejected. In this regards the Levene's test for equality of variance reveals that the homogeneity of variance assumption underlying the analysis of variance test has been violated at 5% level of significance on the basis that the F-test statistic of 2.006 is lower, when compared with a 5%, F(5, 284). As such one can be confident that the population variance of the residential rent in the six neighbourhoods is not equal.

Table 2: Test of homogeneity of variances

Levene Statistic	Degree of Freedom (DF) 1	Degree of Freedom (DF) 2	Sig.
2.006	5	284	0.078

The result of the Analysis of Variance in rents as reported in Table 3 meant that rents varied statistically across the neighborhoods in the study area as F statistic (5.447) is greater, when compared with a 5%, F(5, 284). Therefore the null hypothesis of variation in residential rents in the study area is rejected (P-value of 0.0001 < 0.05). As such the analysis of the multiple comparisons using Turkey Honestly Significant Difference Test can proceed to determine the neighbourhood(s) where difference in rent lies.

Table 3: Analysis of variance for residential rents

Method	Degree of Freedom (DF)	Value	Probability
Anova F-statistic	(5, 284)	5.447	0.0001
Analysis of Variance			
Source of Variation	Degree of Freedom (DF)	Sum of Sq.	Mean Sq.
Between	5	1.25E+11	2.49E+10
Within	284	1.30E+12	4.57E+09
Total	289	1.42E+12	4.92E+09

Turning to the multiple comparisons using Tukey Post Hoc Test in Table 4, a look at the mean difference (column 3 of Table 4) reveals the neighbourhoods where the difference in rent lies. For instance, it is seen that significant differences in rent exist in such neighbourhoods such as Dutsen Kura Hausa, Sabon Gari, Bosso Estate and Okada Road. These differences in rents are significant at 5% level of significance compared to other neighbourhoods (See column 5 of Table 4). Specifically, it is apparent that Duksen Kura Gwari is significant at 3%, Sabon Gari (0%), Bosso Estate and Okada Road at 3% respectively. This further led credence to the results in Table1 in which

neighbourhoods such as Okada Road and Bosso Estate have high disproportionate level of rents relative to Sabon-Gari which has the least mean rent in the study area.

Furthermore the results of the homogeneity subsets in Table 5 further explain the finding that rents are significantly different in Duksen kura Hausa, Sabon Gari, Bosso Estate and Okada Road. For example, an examination of *Subset 1* in Table 5 shows that rents in Sabon Gari are distinct from those of Okada road and Bosso Estate which fall in *Subset 2*.

Table 4: Multiple comparisons of residential rents in the study area

Dependent Variable: rent Tukey HSD				
(I) Neighbourhood	(J) Neighbourhood	Mean Difference (I-J)	Std. Error	Sig. Level
Bosso Estate	Duksen kura Hausa	38911.11111*	12819.39115	0.031169
	Flayout	31372.04301	14516.27272	0.259443
	Okada Road	-883.3333333	11775.36267	1.000000
	Sabon Gari	59715.15152*	16483.80847	0.004618
	Tudun Fulani	28586.90476	12006.72786	0.166481
Duksen-kura Hausa	Bosso Estate	-38911.11111*	12819.39115	0.031169
	Flayout	-7539.0681	15868.40795	0.996974
	Okada Road	-39794.44444*	13406.84017	0.037874
	Sabon Gari	20804.0404	17686.1567	0.847880
	Tudun Fulani	-10324.20635	13610.50004	0.974082
Flayout	Bosso Estate	-31372.04301	14516.27272	0.259443
	Duksen kura Hausa	7539.0681	15868.40795	0.996974
	Okada Road	-32255.37634	15037.57785	0.267385
	Sabon Gari	28343.1085	18952.19046	0.667452
	Tudun Fulani	-2785.138249	15219.43151	0.999971
Okada Road	Bosso Estate	883.3333333	11775.36267	1.000000
	Duksen kura Hausa	39794.44444*	13406.84017	0.037874
	Flayout	32255.37634	15037.57785	0.267385
	Sabon Gari	60598.48485*	16944.68989	0.005439
	Tudun Fulani	29470.2381	12632.02628	0.184380
Sabon Gari	Bosso Estate	-59715.15152*	16483.80847	0.004618
	Duksen kura Hausa	-20804.0404	17686.1567	0.847880
	Flayout	-28343.1085	18952.19046	0.667452
	Okada Road	-60598.48485*	16944.68989	0.005439
	Tudun Fulani	-31128.24675	17106.2814	0.454721
Tudun Fulani	Bosso Estate	-28586.90476	12006.72786	0.166481
	Duksen kura Hausa	10324.20635	13610.50004	0.974082
	Flayout	2785.138249	15219.43151	0.999971
	Okada Road	-29470.2381	12632.02628	0.184380
	Sabon Gari	31128.24675	17106.2814	0.454721
	*The mean difference is significant at 5%			

	level of Significance.

However, rents in Dutsen Kura Hausa fall within both Subset 1 and 2. This reason for this is unclear. Unsurprising, rents of neighbourhoods within subset 1 (31%) and subset 2 (9.2%) are not significantly different from each other. This means that there is dissimilarity in rents within these two subsets since their probability values of 0.31 and 0.092 are greater at 0.05 level of significance.

Table 5: Homogeneity subset for residential rents

Location	N	Subset 1	Subset 2
Sabon Gari	22	66818.1818	
Duksenkura Hausa	46	87622.2222	87622.2222
F-Layout	31	95161.2903	95161.2903
Tudun Fulani	56	97946.4286	97946.4286
Bosso Estate	75		126533.3333
Okada Road	60		127416.6667
Sig.		.310	.092

Means for groups in homogeneous subsets are displayed.
(a) Uses Harmonic Mean Sample Size = 40.598.
(b) The group sizes are unequal. The harmonic mean of the group sizes is used.
Type I error levels are not guaranteed.

Identification of Major Internal Aesthetics in the Study Area

The predominant internal aesthetics were identified through physical inspection of the 290 residential properties in the study area. As seen in Table 6, terrazzo (36.2%) and concrete (30.6%) are the most common type of floor finishes in the study area.

Sandcrete is not often used and represents 5.8 % of the aesthetics internally used in the study area. For wall finishes; plastered block (43.4%) is the predominantly used. Mud, burnt bricks, sand creed and sand plaster are used only in few cases as they fall marginally below 10%.

Table 5: Major internal aesthetics in the study area

Structure	Internal Aesthetics	(%)
Floor	Terrazzo	36.2
	Tiles	27.2
	Concrete	30.6
	Sand screed	5.8
Interior Wall	Block plaster	43.4
	Mud	6.2
	Mud block	13.1
	Burnt brick	9.6
	Sand screed	6.5
	Sand plaster	7.2
	Plaster but not painted	13.7
Ceiling	Card board	23.1

	Wood	30.3
	Asbestos	40.3
	PVC	4.1
	Pop	2.00
Door	Metal	28.2
	Metal and glass	36.5
	Wooden	24.1
	Glass	11
Window	Metal	27.5
	Metal and glass	40
	Wooden	15.1
	Burglary	15.5
	Glass	1.7

For the ceiling; Asbestos and wood represent 40.3% and 30.3% of the aesthetics finishes used from which tenants derive utility in the 6 neighborhoods. However, PVC and POP are only used as finishes in exceptional cases, as they represent, only 4.1% and 2% of the aesthetics employed in ceiling finishes in the case study area respectively. Perhaps this might not be unconnected to the high cost of these construction materials.

For the door, metal and glass which represent 36.5% and metal 28.2% are the most common in the buildings examined within the study area. For Window, metal and glass represents 40% of the finishes while 27.5% are metal; which is the common building finishes in the selected neighborhoods in terms of window finishes. Whereas, for both door and window aesthetic finishes, Glass is seen as not commonly used in the study area.

Quality of Internal Aesthetics in the Study Area

The resultant result of the Likert scaling is the mean aggregate quality score of the 5 internal aesthetics for each neighborhood in the study area as reported in Table 7.

Table 7: Quality of internal aesthetics in the 6 neighborhoods

Bosso Estate	Dusten kura Hausa	F-layout	Okada Road	Sabon Gari	Tudu Fulani
3.20 (1)	2.99(4)	2.81(6)	3.13(2)	2.85(5)	3.06 (3)

In Table 7, good quality of internal aesthetic finishes for the buildings are evident in Bosso Estate (3.20) and Okada Road (3.13), Fair Quality of internal aesthetics in the neighborhoods are in Tudun Fulani (3.06) and F-layout (2.81). Low internal aesthetic finishes in the study area are in Dusten kura Hausa (2.99) and Sabon Gari (2.85). This low internal aesthetics might be connected to the fact that these two (2) neighborhoods are traditional settlements predominantly inhabited by indigenes who are original settlers in the city. Moreover, the rank of all the 5 neighbourhoods in the study area on the basis of the quality of their internal aesthetics as reported in parenthesis (row 2 of table 7).

Relationship between Residential Rents and Internal Aesthetics in the Neighborhood

Since it is obvious that there exist a significant variance in rents of properties within the study area, what evidence exists that such variance is as a result of the quality of the internal aesthetics? For

instance does high quality of aesthetics in Bosso Estate (3.13) and Okada Road (3.20) accounts for the high level of rent in these two neighborhood relative to other neighborhoods?

Before turning to the interpretation of the coefficients of the regression model in Table 4.9 a look at Table 4.8 reveals interesting results of the relationship between rent (dependent variable) and the five aesthetic finishes (wall finishes, door type, ceiling finishes, window material and floor type) as the independent variables. For instance, a diagnostic check of the model reveals that the R^2 shows that 16.7% of the variation in rent of residential properties is accounted for by the quality of building finishes in the study area and that 83.3% is due to other factors.

Table 4.8: Regression model summary of internal aesthetics of dwellings

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R^2 Change	F Change	df1	df2	Sig. F Change	
1	.409(a)	0.167	0.15	64665	0.167	9.444	6	282	0	1.999

(a) Predictors: (Constant), wall finishes, door type, ceiling finishes, window material, floor type
(b) Dependent Variable: rent

Furthermore, the result of the F-test for DF (6,282) shows that the model is adequate and good predictor of the explanatory variables at 5% level of significance, since the table value is less than 9.444. Again, since the Durbin- Watson statistics of 1.999 is almost closer to 2, it means the explanatory variables are not affected by serial correlation (that is the error terms are not correlated).

In Table 4.9 it can be seen from the coefficients of the regression that aesthetics connected to floor type, for example, is the most significant determinant of rent and adds ₦ 13142 to the residential rent of properties in the study area. Aesthetics related to window material and ceiling finishes also add ₦ 8071 and ₦ 8819 to rent and are significant at 5 % level of significance (P-values of 0.012 and 0.018).

Table 4.9: Regression coefficients of the model (a)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Co linearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-26590.452	20122.470		-1.321	0.187		
	floor type	13141.581	4329.217	0.185	3.036	0.003	0.795	1.258
	wall finishes	3349.592	1928.572	0.098	1.737	0.084	0.931	1.074
	door type	-142.625	3321.118	-0.002	-0.043	0.966	0.963	1.039
	window material	8071.366	3188.091	0.146	2.532	0.012	0.888	1.127
	ceiling finishes	8818.835	3691.362	0.138	2.389	0.018	0.880	1.137

(a) Dependent Variable: rent

However, aesthetics for wall, door type and roof type are not significant predictors of rents at 5% level of significance in the study area. In addition, the door type decrease rents in the study area by ₦ 143.

Conclusion

This study has attempted an examination of the underlying structure of residential rent vis-à-vis its variance across the different neighbourhoods in the study area. Secondly, by its experimental nature it has linked variance in real estate residential rents to attributive change in internal aesthetics of dwellings. An interesting result of this study is that aside Sabon -Gari, a inner-core neighbourhood, variability in rent distribution is greatest for properties in F-Layout with such variability decreases with increasing distance from the inner part of Minna where F-Layout is located to further away locations such as Bosso Estate, Dutsen Kura Hausa, Tudun Fulani and Okada road. In this regards, rent control might be a viable tool in the foreseeable future to prevent inequality in rent fixing within the inner part of the city. Within this purview, internal aesthetics account for 16.7% of the total variation in residential rents in the study area. As such property owners and real estate investors must rise to the challenge of improving the quality of internal aesthetics of dwellings especially in Sabon-gari, Tudufulani and Dutsen-Kura to be at parity with other neighbourhoods. This is against the backdrop that the rental price of a house depends of the utility and satisfaction embodied and derived from such aesthetics and these are differently priced by tenants.

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LEGAL ISSUES IN NIGERIAN PROPERTY TAXATION: PROSPECTS AND CHALLENGES

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Abstract
Taxation is one of the oldest sources of public revenue for providing and maintaining public utilities in a civilised society. Property tax is a form of levy or rate payable to a constituted authority by property owners or occupiers for use and enjoyment of social services and public utilities. If properly administered, property tax has the potentials of pumping into the public coffers the required revenue to finance the provision and maintenance of public amenities, with spectacular turnover, if not close to the oil sector. The success of property tax administration heavily relies on the existence of a potent, dynamic and responsive legal structure which will anoint the tax with legality, legitimacy and the indispensably required backup for successful implementation and enforcement. This paper seeks to present the legal framework for property taxation in Nigeria with special focus on the nominal tax legislations presently in force. Although confronted with the absence of any principal legislation on property taxation in Nigeria, this paper founded on the 1999 Constitution, the ace-law of the country, the legality and legitimacy of levying such tax. The paper also advocates for the need to broker a substantive legislation on property taxation towards attaining a sustainable structure for proper administration.

Keywords: administration, law, legislation, property, tax.

Introduction

Nigeria is the most populated country in Africa with more than one-seventh of the continent's estimated population.[1] The impact of the nation's population growth on public utilities is better imagined than described as most of the social services and amenities have been over stretched. Most of the public utilities are seriously begging for update and repairs; this does not overlook the need to extend the provision of such amenities to areas that do not have. Taxation is a viable element in every nation's economic engineering and one of the principal indicators of public revenue mobilisation. In Nigeria, the petroleum sector has, since independence, taken the major part in revenue mobilisation and taxes have been pushed to the background as a collateral source of public finance. Hence tax administration in Nigeria receives not the deserved commitment from the government through effective tax policies capable of matching the demands of the twenty-first century. Taxes imposed in Nigeria are classified as direct and indirect taxes administered vide the three tiers of government, the federal, state and local governments. Direct taxes are company's income tax, personal income tax, petroleum profits tax and capital gains tax; while the indirect taxes include stamp duties, customs and excise duty and Value Added Tax among others. Another form of taxation constitutes the property tax which is the major theme of this paper. Although there is no any principal legislation on property tax, several property related taxes are featured in various legislations in the country.

The property tax is a fundamental instrument of effective land administration in some jurisdictions, unfortunately in Nigeria is where such revenues are collected, they are seldom accounted for:

[1] Stock, R. (2008), *Nigeria*, Microsoft Student.

alas, property tax is very unpopular with homeowners. Some countries impress property taxation as one of the viable channels of managing their land policies towards equitable distribution of land. For instance, the governments in Taiwan and Chile levy taxes on vacant lands to stimulate development in certain zones, in Jakarta, Indonesia, the government collects higher tax rates on land not in use and the Republic of Korea taxes speculative gains in land transactions.[2] In Nigeria, the 1999 Constitution of the Federal Republic of Nigeria provides the constitutional basis for property taxation, unfortunately, this warrant is not being utilised to properly enlist one of the most vibrant sources of public revenue at the local levels. This paper intends to examine the efficacy of the legal framework for property tax administration in Nigeria; the paper also uses the words 'tax' and 'taxation' interchangeably as the two words are highly correlative overlapping meanings.

Meaning of Taxation

The system by which a public authority imposes certain levies, rates or duties on its subjects for the purpose of raising revenue is known as taxation.[3] "[A] tax is compulsory contribution, imposed by government, and while tax payers may receive nothing identifiable in return for their contribution, they nevertheless have the benefit of living in a relatively educated, healthy and safe society." Also Okoni quoted Nightingale as she further explains that taxation is "part of the price to be paid for an organized society.[4] Accordingly, taxation is one of the most volatile and a delicate subject in governance as it is often viewed with contempt and resentment both in developing and developed countries. It is, therefore, no surprise that some of the most familiar quotations in history have been comments by famous men about taxes. Benjamin Franklin once remarked, "In this world, nothing is certain but death and taxes."[5] Chief Justice John Marshall in the United States of America was quoted saying: "the power to tax involves the power to destroy." [6] The above quotations show clearly the volatility of taxation, as it can be a factor of public development and in some cases can be the spark that triggers civil unrest and protests.

However, taxation cannot be generally blacklisted as the primary object of taxation is to enhance public convenience. Nightingale identified six reasons for taxation: provision of public goods, redistribution of income and wealth, promotion of social and economic welfare, economic stability, harmonization and regulation.[7] In support of the public-good argument as one of the basis for taxation, Murphy and Nagel[8] argued that, "...The ends that may be claimed as legitimate for the state and that affect tax policy can be ranged under three headings: public goods, benefits to individuals, and distributive justice. ...Public goods are defined as those that cannot be provided to anybody unless they are provided to everybody. If violent crime[s], environmental pollution, the threat of fire, or communicable diseases are kept under control in a territory, then everyone living in that territory automatically benefits, and no one can be excluded. If one tried to support such goods by private subvention, there would be no way of excluding free riders, who would enjoy the good without paying - at least no way short of exile. The obvious way of getting everyone to pay their share is through taxation, coercively imposed." The foregoing opinions seems to place taxation within the context of social contract between the citizen and state wherein the citizen empowers the state by way of making contributions towards provision of what he wouldn't otherwise possibly enjoy without others.

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[2] Ogedengbe, P. S. (2004), *Formulating a Good Urban Land Policy for Nigeria*, J. Hum. Ecol., 15(2): p. 91-96.

[3] Nightingale, K. (2001), *Taxation: Theory and Practice London*, Prentice Hall.

[4] Okoni, O. (2006), Governance, Taxation and Fiscal Policy in Nigeria. *European Journal of Economics, Finance And Administrative Sciences - Issue 6*, p. 41

[5] Pechman, J.A. (1985) *The Promise of Tax Reform Englewood Cliffs*, Prentice-Hall Inc: p. 1.

[6] Ibid., p. 1.

[7] Nightingale, op cit.,

[8] Murphy, L. and Nagel, T. (2002), *The Myth of Ownership: Taxes and Justice*, Oxford University Press, New York, p. 46.

Nature of property tax

Property tax is compulsory revenue levied on interests in private ownership and use of landed properties and similar assets which includes ground rent, tenement rate, probates tax, capital gains tax, capital transfer tax, stamp duties etc. This source of revenue is used by the government to defray the cost of providing and maintaining social services to the owners and occupiers of properties within specific area covered by jurisdiction of the collector. Social services and amenities contemplated herein include services mostly rendered by the local government councils; this therefore establishes that the local or municipal governments are visible contingents in property tax administration. Major heads of property tax are explained thus:

1. *Ground Rent:* this is a form of annual rent paid to the state government by the holder of a Certificate of Occupancy for the occupation of the land whether it is developed or not.[9]
2. *Tenement Rate:* is a local form of taxation levied on property and paid to the Local Government Council[10] by the owners or occupiers of the property. It is a tax on the occupation of property, the proceed of which is used for funding Local Government social services or to finance construction and maintenance of roads, drainages, refuse disposal, markets, slaughter houses, burial grounds, public conveniences, maintenance of primary schools, and maternity clinics among others.[11] The tax is aimed at promoting the total well being of inhabitants of the local community payable on annual basis on the value of each property within the Local Government Area Council.[12]
3. *Probates Tax:* this is levied on total value of property which is subject of inheritance, also known as inheritance tax or estate duty.[13]
4. *Capital Gains Tax:* imposed on the income or proceed accruable from transactions on land by way of sale, tenancy etc.[14]
5. *Capital Transfer Tax:* this is levied on the total value of property transferred by way of gift or bequest (i.e. will).
6. *Stamp Duties:* payable *ad valorem* (i.e. proportionate to the value of the property covered by the conveyance, lease of mortgage sought to be registered, and the payment and stamping must be completed within 30 days of execution default of which attracts penalty.[15]

In Nigeria, determination of the enumerated taxes above depends more often on the value of the property, but the computation of ground rent which is exclusively paid for the land alone. The Republic of Mongolia, a third-world country in Asia largely depends on property tax as one of its vibrant sources of revenue and as such maintains a sound property tax administration structure. Determination of property tax in Mongolia is thus, "The value of immovable property is determined, firstly, by the valuation registered with immovable property state registry. If there is no such registration, the value is determined by the valuation of insurance on the property. And if there is no registration or insurance valuation, the value will be established as the value that is written down in accounting books."[16] Success of this however largely depends on proper land registration and

[9] Sections 10(b) and 16, Constitution of the Federal Republic of Nigeria 1999.
[10] Fourth Schedule, paragraph 1(j), 1999 Constitution.
[11] Olusegun, K. (2002), *Principles and Practice of Property Rating*, TTP, Nigeria, p. 28.
[12] Ekong, E. (2007), *Nigeria: An Overview of the Proposed Property Taxation in FCT*, Daily Trust (Abuja), 14th November, Edition.
[13] Order 49, Rule 11, High Court (Uniform) Civil Procedure Rules, No. 56, 1989.
[14] Section 3, Personal Income Tax Act Cap. P8, LFN 2004.
[15] S. 23(1) and (3), Stamp Duties Act Cap. 411, LFN 1990.
[16] Article 5, IMMOVABLE PROPERTY TAX LAW OF MONGOLIA 17 November 2000.

adequate documentation. Unfortunately, these are the major low-points hindering effective land management by the government as Nuhu[17] reported Ukaejiofo thus, "Nigeria is endowed with a vast land mass of about 924, 768sq.km and as today, less than 3% of the total land area can be tied to a well documented record of the use and user."

The Nigerian experience shows that property taxation has limited revenue potential firstly because the nation places higher priority on oil revenue and secondly because in many cases it has proven difficult to administer. To ensure effective utilisation of property tax policies in Nigeria, the government needs to midwife a vibrant legal and administrative structures that will hasten documentation of land transactions so as to assist the government in implementation towards sound revenue mobilisation for municipal development. The only fully appropriate tax base for local governments would appear to be property tax. Since proper and effective administration of property taxation is perceived to contain the potentials of poverty eradication,[18] the proper authority must take more than a casual stride to ensure its success. In the United States, state and local governments generally levy property taxes on buildings - such as homes, office buildings, and factories—and on land. By the year 2000 property taxes accounted for 2.0 percent of state tax revenues and 72 percent of local tax revenues in the United States.

The Canadian constitution also allows the federal government to levy property taxes, however, currently only local and provincial governments collect such taxes. The property tax is by far the largest source of revenue for local governments.[19]

The Legal Framework for Property Tax in Nigeria

The significant question which persistently begs to be answered is whether there is any uniform principal legislation on property taxation in Nigeria. The answer to this question is not in the affirmative and a cursory look at what seems to be the property tax law in Nigeria reveals the weakness of its structure. It is trite that any tax which is not prescribed by law is illegal and unenforceable; in ***7up Bottling Company v. Lagos State Internal Revenue Board***[20] the court states that:

It has often been the view of the Courts here and elsewhere that if a person sought to be taxed comes within the letter of the law, then such a person must be taxed. On the other hand, if the tax authority seeking to recover tax from a person is unable to bring him within "the letter of the law", the person will be free, however apparently within the spirit of the law his case ought otherwise appear to be."

It is imperative to note at the onset that property taxation in Nigerian law is constituted by a patchwork of statutes passed by states and local government authorities. Property taxes can only derive legitimacy to the extent that they are recognized within the country's legal structure. To reinforce this position, the Federal Supreme Court was apt as it stated thus, **"**No tax can be imposed on the subject without words in an Act of Parliament clearly shewing an intention to lay a burden on

[17] Nuhu, M. B. (2008) *Land tenure and management of Nigerian cities* Wednesday, Daily Trust, 21st May 2008 Edition, http://www.dailytrust.com

[18] Patunola-Ajayi, B. J. *Nigeria: Property Tax as Tool for Poverty Eradication*, Vanguard (Lagos), Oct. 11, 2007 Edition, http://www.vanguardngr.com.

[19] Microsoft, *Encarta*, 2008. © 1993-2007 Microsoft Corporation.

[20] [2000] 3 NWLR p. 565-591.

him."[21] The auxiliary provisions that prescribe property taxes could be found under the following legislation:-

Constitution of the Federal Republic of Nigeria 1999

The 1999 Constitution is the principal law which provides the basis of all legal rights, liabilities and responsibilities in Nigeria. Under the fundamental objectives and directives of state policies, the Constitution adumbrated payment of taxes including property tax as a civic responsibility of all citizens. It states under section 24 that, "It shall be the duty of every citizen to- declare his income honestly to appropriate and lawful agencies and pay his tax promptly". The power to make and impose tax laws in Nigeria is distributive as both the national and state assemblies (Federal and state governments) can make laws on taxation as specified under the concurrent legislative list of the Constitution.[22] Hence, every state has the power to create its taxation system for the purpose of generating revenue for public convenience to the extent that it does not contradict any tax law passed by the federal legislature.[23] By the foregoing, government has the constitutional mandate to impose taxes and for the purpose of this discourse, other auxiliary provisions on property tax in numerous Nigerian legislations are relevant. It is therefore constitutional for appropriate public authorities to levy and collect property tax in Nigeria, provided such is prescribed by a law duly passed by the national or state houses of assemblies. The Constitution is also clearly instructive as it apportions the responsibility of collecting a portion of property tax on the Local Government Councils in the country.[24] For the purpose of clarity this paper shall consider in details the role of Local Government Councils in the administration of property tax in Nigeria under the next sub-theme. At this point, it manifests that the constitutionality of property tax in Nigeria is free from controversy, and the constitution has not centralized the system of its administration as every state in the federation is free to make its property tax laws.

The Land Use Act[25]

The Land Use Act, hereinafter referred to as the 'Act' came into force in 1978 and has since then become the corner-stone of Nigerian land administration. Its legislative spirit insulates the spectrum of the nation's land policy which rests legal interest in land within territories of each state on the state governor as the statutory trustee. Under the Act, the governor has the power to levy ground rent as rental on land.[26] Also, section 10(b) provides that the holder of a certificate of occupancy is bound under the terms of grant of occupancy to pay such rent fixed by the governor for the use and enjoyment of the land as prescribed under S.16 which provides thus:

> *In determining the amount of the original rent to be fixed for any particular land and the amount of revised rent to be fixed on any subsequent revision of the rent, the governor - Shall take into consideration the rent previously fixed in respect of any other like land in the immediate neigbourhood and shall have regard to all circumstance of the case.*

The foregoing provision deals with the determination of ground rent which is the original rent[27] and in so doing the Act directs the governor to take into consideration the rent previously fixed in

[21] ***Authority v. Regional Tax Board, Attorney-General of the Western State of Nigeria and Adelaja*** **[1967]** NCLR 452-464.

[22] Part II, Second schedule paragraphs 7, 8,9 and 10.

[23] Section 4(5), 1999 Constitution.

[24] Paragraph 1(6) of the 4th Schedule.

[25] Cap. L 5, LFN, 2004.

[26] Section 5(1)(c).

[27] Alubo, A. U.(2005), *Contemporary Nigerian Land Law,* ABESON, Nigeria, p. 36.

respect of any other lands in the neighbourhood where the land under consideration is located. While the governor must not act arbitrarily, he shall also not take into consideration any cost or expenditure included on the land which is likely to raise the value of the building or the improvement on the land. This position is shrouded with ambiguity as the Act fails to register the possible variation in sizes of lands within a neighbourhood.

The Act should have computed this incidence of assessment into a numerical value capable of mathematical computation based on the land size or the improvement on land. To ensure a fair and just application of this provision, the ambiguity, must be resolved in favour of the tax payer, i.e. the amount payable must be based on a fair valuation. Taxation, according to the courts, is one of the expropriatory encroachments on the private property rights of citizens. In stressing how the courts view these expropriatory legislations, the Supreme Court of Nigeria, per Hon. Justice Uwaifo, J.S.C. (as he then was), states that:

> *"It is the law that in interpreting a statute which encroaches on a person's proprietary right, the courts' attitude must be to adopt the principle of strict construction, fortissimo contra proferentes [strictly against any one claiming benefit], which leans in favour of the citizen whose property rights are being denied; and against the interest of the lawmaker…"*[28]

Another gateway that leads to a clearer horizon could be found in adopting the purposive construction rule by the courts when construing tax legislations. In the English case of ***Pepper v. Hart***[29] Lord Griffiths states that: "The courts now adopt a purposive approach which seeks to give effect to the true purpose of the legislation." Hence, judges may be at liberty to read in words not used in the legislation to interpret it: so as to clearly reflect in their decisions the intentions of the legislature.[30] The court should look beyond the words used to the entire text, and the context in which they are used to bring out the purpose of the legislation. It is the humble opinion of this writer that in applying the purposive approach, the court must employ diligent care and extreme caution so as not to go into legislation arena by creating a tax where none is technically contemplated by the provision.

The Act is not very clear as per the role of local government councils in property tax administration. Nonetheless many writers have favoured the opinion that the local councils are more instrumental to this system of taxation than the state authorities. It is not clear whether none inclusion of local councils in the determination and administration of property tax under the Act is deliberate or it is a major omission, but in its penal provisions, the Act gives Local Government Council the power to institute legal proceedings in its name against any default in payment of rent.[31] It can be deciphered from the foregoing that indeed the local councils have a germane role to play in property tax administration and to clarify this, the Constitution provides that the main functions of the Local Government Council among others, include:

Assessment of privately owned houses or tenements for the purpose of levying such rates as may be prescribed by the House of Assembly of a state...[32]

The practice today is the Local Governments collect tenement rates in respect of lands within their territories as prescribed by their state Houses of Assembly while the State Governments collect

[28] ***Victor Manyo Ndoma-Egba v. Nnameke Chikwukeluo Chukwuogor and Ors***.[2004] 6 NWLR 382-434.
[29] [1993] AC 593 at 617.
[30] Lee, N. (1999), *A Purposive Approach to the Interpretation of Tax Statutes*, 20 Stat. L.R. 124 at 128.
[31] Section 42(1) Land Use Act.
[32] Fourth Schedule, paragraph 1(f).

ground rents. It is important to note that the statutory trust[33] created under the Act does not vest in the governor the power to determine the rates payable in property taxation but the state House of Assembly.

Tenement Rate and other Rating Laws

The local governments being the third tier of government are constitutionally empowered to levy and collect tenement rate in form of annual taxation levied on built property. Application of this taxation automatically excludes undeveloped property. Local authorities make these laws by way of subordinates legislations and bye laws; however, some states of the federation pass these laws to be applicable in all the local government areas of the respective states.[34]

Other Tax Legislations and Property Tax

Apart from the foregoing, other tax related laws have indirectly levied taxes on properties by attaching charges to the incomes accruing from the property. These laws include the Personal Income Tax Act[35] which levies tax on income accruing to the property by way of sale, lease etc., under this Act, the income chargeable is the net-income which accrues to the property. Personal Income Tax is imposed on resident individuals, trusts, estates and unincorporated entities at graduated rates of 5-25%. An individual is deemed resident in Nigeria for tax purposes if he is domiciled in Nigeria; sojourns in Nigeria for a period or periods amounting to 183 days or more in a twelve-month period, or serves as a Nigerian diplomat in a foreign country. A non-resident individual is a person who is not domiciled in Nigeria or who is present in Nigeria for a period less than 183 days. A non-resident individual is liable to pay tax on income derived from a trade or business carried on in Nigeria, irrespective of the duration of the trade or business.[36] Secondly, indirect taxes with probable consequences of affecting property ownership and its management or transfer in Nigeria are charged under the Value Added Tax Act.[37] Although this does not affect the property *per se*, it seriously tells on developing and maintaining the property (i.e. it levies on building materials and utility bills) and besides, it is conceivable that 'property' does not appear among the non-taxable items as specified in the exemptions or negative list in the schedule to the Value Added Tax Act. In this category also is the payment for stamp duties charges upon registration of conveyances of landed properties under the Stamp Duties Act,[38] states also operate this tax through their respective stamp duties laws.

The Austinian school of thought views law as "a command of the sovereign to his subjects backed by a sanction."[39] This view is relevant here to the extent it shows that mere imposition of property tax by way of utilising the laws enumerated above cannot guarantee compliance, the law must have provided a sanction against noncompliance. Noncompliance with tax regulations amounts to an offence and fortunately, some of the laws have prescribed the relevant penalties. Major tax related offences include:

i. *Tax evasion*. This offence is constituted where a taxpayer refuses to disclose taxable income or property, and where such disclosure is made, the tax payer claims unauthorised tax deductions.
ii. *Tax avoidance.* This occurs where a taxpayer pays the minimum tax by claiming all allowable deductions.

[33] Section 1 Land Use Act.
[34] Example is the Niger State Tenement Rates Law 1995.
[35] Op cit.
[36] Nigeria Tax News, Vol. 1 Issue No. 001, Abraham & Co., 2008, p. 1..
[37] Cap. V1 LFN, 2004.
[38] Op cit.
[39] Elegido, J. M. (2000), *Jurisprudence,* Spectrum, Nigeria, p. 52.

iii *Withholding tax*. This is a situation where a person authorised to collect taxes fails to turn-over or remit same to the appropriate authority.

Under the various tax laws, all the above offences attract various sanctions ranging from revocation of right of occupancy,[40] fine,[41] and imprisonment.[42]

Conclusion

The property tax regime in Nigeria is not centralised as the Constitution has apportioned the responsibilities of its administration to the three tiers of government, and because the local government council is at the grass-root strata and thus constitutionally empowered to provide the social services and amenities, it is positioned to collect some of these revenues for finance of those services, yet this source of revenue remains grossly underutilised. Below are outlines of some of the limiting factors against the smooth flow of property tax administration in Nigeria:

(i) Absence of a substantive property tax law which will clearly define the governing principles of property tax administration, and which will likely consolidate the nominal provisions into a single statute for easy implementation and to avoid dual taxation.

(ii) The existing local government structures are not effectively equipped to administer this tax as the final determination always lies with the state government.

(iii) Absence of a comprehensive land registration policy has left most of the properties that could otherwise provide taxes outside the purview of public tax register; hence monitoring ownership of land is practically impossible.

(iv) More often, funds so far collected on tenements and other property related levies cannot be accounted for because improvements and innovation do not take place in management of the existing public utilities. This has a serious effect of demotivating the taxpayer. It was reported that all countries face problems resulting from citizen unwillingness to make contributions through the property tax for nonexistent or poor quality services.[43]

(v) Absence of the government's political will to focus on property taxation as the pursuit of oil dollar wins the top priority in the national revenue agenda.

(vi) Because most estate transactions are conducted privately and outside the state's scrutiny, it becomes impossible for government to stretch its hands to the incomes other than the registration charges and the payment for stamp duties where registration is contemplated.

Recommendations

Dillinger argues that, "The match between incidence of the property tax and the benefits of the service it finances is clearly far from perfect: the statutory burden of the property tax is distributed according to value of property; the benefits of the services it finances are not. The benefits of refuse collection, for example, are more proportional to household size than property value. Nevertheless, the property tax is more effective at confronting taxpayers with the cost of local services than are the other revenue sources that might be assigned to local government."[44] Therefore proper utilisation of this revenue is germane to the success of property taxation, and along this line, this paper closes with the following recommendations:

[40]Section 28(5)(a), Land Use Act, op cit.

[41] Sections 94-101, Personal Income Tax.

[42]***7up Bottling Co. Plc.,*** *supra*.

[43]Municipal Development Programme (MDP), Harare, Zimbabwe, November, 1995.

[44] Dillinger, W. (1991), *Urban Property Tax Reform Guidelines and Recommendations*, Infrastructure and Urban Development Department, The World Bank, p. 3.

(i) Property tax reform must be integrated into the national agenda with intensive commitment and due political consideration; the objectives and procedures be adequately publicised in simple terms for the tax payer to understand.

(ii) The stakeholders in the estate industry, Nigerian Institution of Estate Surveyors and Valuers (NIESV), Estate Surveyors and Valuers Registration Board of Nigeria (ESVARBON), the Nigerian Bar Association (NBA) etc. should launch a formidable case for the concerned authority to come up with a workable system of property taxation to be anchored on a comprehensive property tax law.

(iii) Since human resources play a significant role in the process of administering the property tax system, improved tax policy or legislation is not enough a panacea if the human resource base is weak or insufficient. Quality personnel with sound professional training must take over the estate industry majority of which is left for 'quacks' to steer. Special training is required for effective valuation, cadastre management appraisal, collection, and other professional and administrative functions of the tax system.

(iv) The government should initiate a strategic exercise for identification of property sites and ownership, record-keeping, valuation, assessment, billing and collection, and enforcement as proper documentation provides the headway to the success of property tax system.

Finally, having identified the limited capacity at the local government level to administer property taxes, despite its relevance for grassroots development, the state can liberalise the system to enable the local councils to effectively administer their taxes according to their peculiarities for their sustainable development. On the other hand, administrative functions such as the collection and enforcement of property taxes should ideally and exclusively be allocated to the local level.[45]

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BIODEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) FROM PAIKO OIL DEPOT USING A MIXED CULTURE OF BACTERIA

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Abstract
Petroleum development and production have resulted in soil degradation, the generation of air and water pollutants, solid and hazardous wastes. In this study, the degradation potential of polycyclic aromatic hydrocarbons (PAHs) was investigated using a consortia of mixed bacterial culture. Phenanthrene, a three-ringed angular PAH, known to be a human skin photosensitizer and mild allergen was used as a representative of PAH to study the degradation efficiency of a mixed culture of bacteria and fungi. Microorganisms were isolated from hydrocarbon contaminated soils of Pipeline Product Marketing Company Paiko depot, Niger State. The degradation experiments were conducted in liquid cultures. The initial phenanthrene concentration was 60 mg/l at the beginning of degradation experiments. After fifteen days incubation, the mixed culture was capable of degrading about 17% of the phenanthrene with a bacterial population of about 1×10^8 CFU/g. The mixed culture achieved a 100% degradation of the phenanthrene after 34 days. The Lineweaver-Burk plot was used to observe the correlation between the rate of degradation (V_o) and the concentration of the substrate ([S]). The value of Michealis constant (K_M) was determined to be0.00 mg/l.

Keywords: PAH, Phenanthrene, Bacteria, Contaminated soil

Introduction
The contamination of soils with xenobiotic compounds due to industrial activities is widespread. The degradation of soils with polycyclic aromatic hydrocarbons (PAHs) has been implicated into environmental and human health problems since these compounds are toxic, mutagenic and has a carcinogenic potential (Acevedo, 2010). Polycyclic aromatic hydrocarbons (PAHs) comprise of a large and heterogeneous group of organic contaminants which are formed and emitted as a result of the incomplete combustion of organic material (Kumara *et al.*, 2006, Bamforth and Singleton, 2005). PAHs are ubiquitous in the natural environment, and originate from two main sources: natural (biogenic and geochemical) and anthropogenic (Bamforth and Singleton, 2005). These compounds are produced by industrial activities such as oil processing and storage, and are often found in contaminated soil (Kim *et al.,* 2001). PAHs are fused-ring compounds that enter soil systems and natural waters via wastewater effluents from coke and petroleum refining industries, accidental spills and leakages, rainwater runoff from highways and roadways, or from intentional disposal in the past (Karthikeyan and Bhandari, 2001). The inertness of these compounds, their low water solubility and strong lipophilic character lead to very high accumulation levels in the environment (Parviz *et al.,* 2006). The persistence of PAHs in the environment is dependent on a variety of factors, such as the chemical structure of the PAH, the concentration and dispersion of the PAH and the bioavailability of the contaminant (Bamforth and Singleton, 2005). Besides this, they possess physical properties, such as low aqueous solubility and high solid water distribution species ratios, which stand against their ready microbial utilization and promote their accumulation in the solid phases of the terrestrial environment (Muller *et al.*, 2004).

Polycyclic aromatic hydrocarbons (PAHs) also comprise of a large and heterogeneous group of organic contaminants but the most toxic members of this family known to date are PAH molecules

that have four to seven rings (Fatai, 2010). The United States Environmental Protection Agency currently regulates sixteen (16) PAH compounds as priority pollutants in water and generally considers them as "total PAH" (tPAH) in contaminated soils. The 16 regulated PAHs comprise both low and high molecular weight, and seven of them are designated as known human carcinogens (Arbabi *et al.*, 2009). All of the carcinogenic PAH (cPAH) are high molecular weight compounds, hence the improper management and disposal of oily sludge wastes may cause environmental pollution, particularly to the soil and groundwater systems, due to their low volatility and aqueous solubility (Fatai, 2010). PAHs are also recalcitrant in nature and they have high affinity for soil material and particulate matter (Kumara *et al.,* 2006, Bamforth and Singleton, 2005). Overtime, they will accumulate to the extent that they become harder to eliminate (Fatai, 2010). It is also important to note that many of the constituents of PAHs are not only carcinogenic and mutagenic, but they are also potent immune toxicants (Acevedo, 2010). Bamforth and Singleton (2005) reported the impacts of PAHs on critical habitats such as the benthic ecosystems, which may ultimately get into the marine food chain. The recent research and development in the area of PAHs disposal management is focussed on the biodegradation method, which is considered as the effective and sustainable means of controlling the effects of PAHs on the environment.

A good number of researchers have shown interest in the biodegradation mechanism and environmental fate of PAHs as a result of their ubiquitous distribution and their potentially deleterious effects on human health. (Obayori and Salam, 2010). Microbial research over the last two decades have shown that more than 160 genre of bacteria including *Psuedomonas, Alcaligenes, Vibrio, Mycobacterium, Comamonas, Rhodococcus, Neptunomonas, Naphthovorans, Cyanobacterium* and *Cycloclasticus* are capable of degrading PAHs to derive energy and metabolic building blocks (Berardesco et al., 1998). Bacteria generally require the mono- or di-oxygenase enzyme system to break PAH rings (Kulisch and Vilker, 1991). Compared to physicochemical methods, biodegradation offers an effective method for the treatment of crude oil pollution because the majority of molecules in the crude oil and refined products are biodegradable and oil degrading microorganisms are ubiquitous (Chaîneau *et al.*, 2003). Several microorganism with an innate ability to degrade phenanthrene - based contaminants have been identified and extensively studied (Karthikeyan and Bhandari, 2001, Abd-Elsalam et al., 2009, Parviz *et al.,* 2006). In this work therefore, the degradation of phenanthrene, a representative PAH was studied to determine the effectiveness of a mixed culture of bacteria in the degradation process. The scope of this work is limited to the biodegradation of phenanthrene in a petroleum depot contaminated soil.

Methodology

Collection of Soil Sample

Soil sample was collected in the range of 3-4 kg from surface and 10 cm deep layer of petroleum contaminated soil at the Pipeline Product Marketing Company, Paiko depot, Niger State. Prior to conducting any analysis on the collected soil sample, the coarse pieces e.g., stones and debris were separated using a sieve and the remaining were mixed well. The sub samples were kept cold in a refrigerator (3-5) °C to be used for isolation of microorganisms.

Extraction of PAHs from Soil Sample

The solid sample (contaminated soil) was placed into an extraction thimble (Pyrex England) where available PAHs were extracted using n-hexane as the solvent. After the solvent had been boiled, the vapour passed through a bypass arm into the condenser where it condensed and dripped back onto the solvent in the thimble. As the solvent got to the top of the siphon arm, the solvent and extract were siphoned back onto the lower flask whereby the solvent reboiled, and the cycle was repeated until the sample was completely extracted into the lower flask (Arbabi *et al.*, 2009).

High Performance Liquid Chromatography of Extract

Extracts from the soxhlet extractor were analysed by high performance liquid chromatography (HPLC) (water 600) equipped with ultraviolet (UV) detector (Shimadzu, Japan). Analytical column (250 mm long, 4.6 mm diameter) was packed with totally porous spherical C-18 material (packed size, 5 µm). Acetonitrile-water mixture (75:25) was used as mobile phase at a flow rate of 1.0 ml/ min. Sample (20 µl) was injected into column through sample loop. UV- detector was set at 254nm for compound detection. Stock solutions of PAHs were prepared by dissolving PAHs analytical standard (200-1000 ppm) in acetonitrile. Working standard (10 ppm) PAHs mixture was prepared by suitable dilution of stock solution with acetonitrile. Calibration graph at several dilution of standard mixture of individual compounds of PAHs were used for determining retention time and studying linearity of detector. Concentration of PAHs was calculated by comparing peak areas of sample chromatogram with that of peak area of standard chromatogram (Arbabi *et al.*, 2009)

Soil Microbial Analyses

Microorganisms were extracted from the contaminated soil by mixing of 1g soil with 10 ml of sterile $Na_2P_2O_7$ solution (2.8 g/liter) in 50 ml erlenmayer for 2hrs on a shaker (250 rpm). The soil particles were allowed to sediment for 30 mins. the supernatant was diluted and plated on solid media. Initial microbial analysis was conducted both for fungi and bacteria. Fungi determination test was carried out on solid media of heterotrophic plate count (HPC) containing chloroamphenicole and cyclohexamide compounds for inhibition of bacterial growth. The total Colony Forming Unit (CFU) was determined using plate count agar using Heterophilic Plate Count Agar (HPC) and Brain Heart Infusion (BHI) agar media. Also MPN (most probable number) analyses were conducted using lactose broth media with 15 tubes method (Arbabi *et al.*, 2009).

Microorganisms were extracted from the contaminated soil and the supernatant after dilution by 10^{-3} -10^{-5} times with sterile distilled water and then plated on solid media (BHI). After separation of bacteria, the stock samples of separated microbes were prepared by the addition of 500 µl of glycerine (Arbabi *et al.*, 2009).

Operation Techniques, Using Pilot Plant

A biodegradation concept which uses artificial air flow (Technique known as Bio venting) was selected for decontamination of PAH-contaminated soil. After the addition of microbial mixed culture, MSM containing P&N (phosphorus and nitrogen) and moisture (about 20 %), phenanthrene were filled into the bioreactor in the pilot plant. The supplied air was passed through distilled water in order to prevent reduction of water content. Also to prevent the distribution of off-gas resulting from phenanthrene decomposition, a 4 M NaOH solution was used as an absorbent (Arbabi *et al.,* 2009)

Table 1: Specification of prepared mineral salt medium

Compounds	MSM
K_2HPO_4(g/l)	0.55
NH_4Cl(g/l)	0.90
KNO_3(g/l)	1.75
Na_2SO4(g/l)	2.00
$MgSO_4.7H_2O$(g/l)	0.30
TES(ml)	1.00
pH	6.5-7.2

Results and Discussions

The initial analysis of soil for the determination of fungi yielded a negligible growth on the solid media. Bacteria population analysis as CFU/g for the soil sample is depicted in Table 2. Likewise, other necessary properties of collected contaminated soil (such as phenanthrene concentration, moisture content, pH etc) were analyzed and the result obtained is presented in Table 2.

Table 2: Microbial and Physico-chemical specifications of PAH contaminated soil samples

Properties	Quantity
Initial phenanthrene conc.(mg/l)	60
Microbial population (CFU)	1.0×10^{9}
Moisture content (%)	3.2
pH	7.1
Bulk density (g/ml)	0.7

Table 2 shows the results of microbial and physico-chemical analysis of the soil obtained from the PAH contaminated site in Paiko. The initial phenanthrene concentration was found to be 60 mg/l, moisture content was found to be 3.2 % with a pH of 7.1 and bulk density of 0.7 mg/l.

Table 3: Bacterial population changes over time in the contaminated soil.

Time (days)	Bacteria population(CFU/g)
0	1×10^{9}
2	5×10^{7}
4	7×10^{6}
6	9×10^{5}
8	8×10^{5}
10	3×10^{6}
12	4×10^{7}
14	9×10^{7}
16	1×10^{8}
18	3×10^{8}
20	4×10^{8}
22	6×10^{8}
24	7×10^{8}
26	8×10^{8}
28	9×10^{8}
30	9×10^{8}
32	9×10^{8}
34	8×10^{8}
36	6×10^{8}
38	8×10^{7}
40	4×10^{5}

Table 3 illustrates the bacteria population growth over time. The first four days of contacting the PAH contaminated soil with the cultured bacteria showed that the bacteria population reduced rapidly. This might be due to the fact that the bacteria were not well adapted to the environment (lag phase) and the effect of toxicity of phenanthrene. But after the lag phase, bacterial growth increased gradually between the tenth and the fifteenth day and then rapidly between day sixteen and day twenty-eight (exponential phase). After the twenty-eighth day the bacteria growth entered the stationary phase and the population changes was constant for a period of four days before finally reducing immediately after the stationary phase. This reduction in population was as a result of lack of substrate for the bacteria to feed on. This observation shows close proximity to the report of Arbabi *et al.,* 2009.

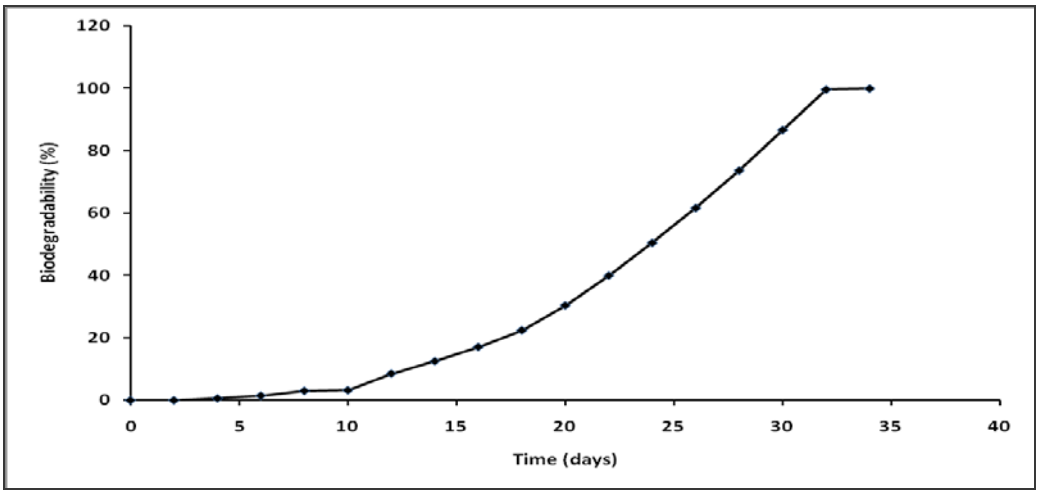

Fig. 1: Biodegradability efficiency of the bacteria

Figure 1 shows the biodegradability efficiency of phenanthrene as a function of time of biodegradation. It was observed that 100 % degradation was achieved after thirty-four days of bio-treatment. This implies that the biodegradation of phenanthrene was effectively completed within this period. This result shows appreciable consistency with the result of Bishnoi *et al.,* 2008 in which 98.6 % degradation was achieved after 42 days of bio-treatment.

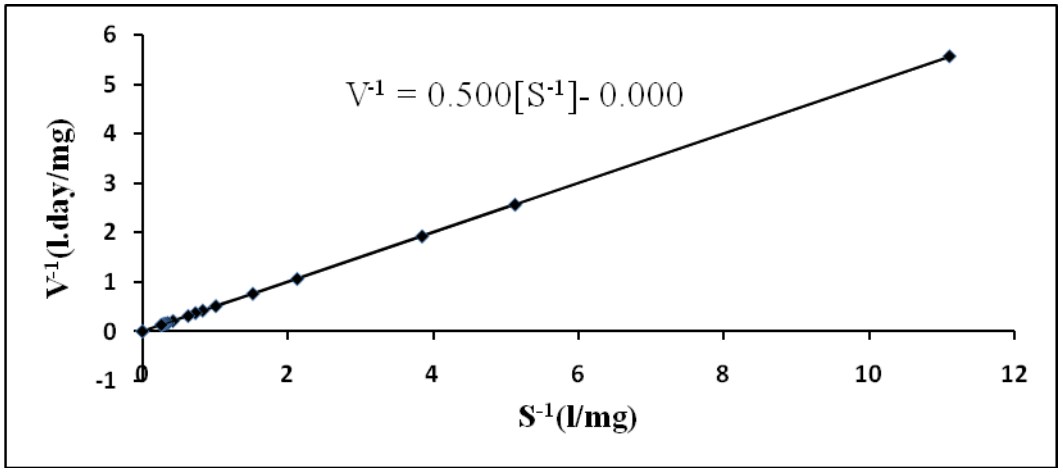

Fig. 2: Lineweaver – Burk Plot of rate against concentration

Figure 2 is a Lineweaver-Burk plot showing the correlation between the rate of degradation (V_o) and the concentration of the substrate [S]. From the graph, the slope and the intercept obtained were 0.50 days and 0.00 (l.day)/mg respectively from which the value of Michealis constant (K_M) which is the constant of degradation was determined to be 0 mg/l

Conclusion

The biodegradation of polycyclic aromatic hydrocarbon (phenanthrene) by bacteria culture was successfully carried out. Results of the microbial analysis, shows that the prepared media contain only bacteria are available for the biodegradation process as there was no growth for fungi on the medium. It can be concluded that the mixed culture of bacteria used in this study are capable of removing the PAH from the soil. The result of this study clearly attest that mixed culture of indigenous bacterial can be effectively used to degrade PAH specifically phenanthrene as 100 % degradation efficiency was achieved after 40 days of bio-treatment. Generally, it can be concluded that contaminated soil can best be treated or decontaminated by microbial actions basically because of its simplicity, efficiency and cost effectiveness.

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DEVELOPMENT OF AN EMPIRICAL HYDROLOGIC MODEL TO DETERMINE MANNING AND RUNOFF COEFFICIENT FOR SOME SELECTED SOILS OF THE PERMANENT SITE OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIA

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Abstract
The determination of the volume and rate of movement of surface water within a watershed are the fundamental steps upon which the design of reservoirs, channel improvement, erosion control structures and servers as well as agricultural, highway and various drainage systems are based. The concept of integrated watershed runoff coefficient has emerged as a new understanding for the interactions between the surface and subsurface pathways of water. A runoff plot was set up to measure surface runoff for the type of soil under controlled conditions. The plot was established directly in the project area with a slope of 9% and length of 22.9 m. Several runs of the experiment were conducted on the plot to help determine the type of parameters (amount of surface runoff, time of concentration, slope, and rainfall intensity) that will be considered for the development of the model. The model developed for this study is $T_c = 0.938L^{0.878}n^{0.324}\theta^{-0.222}S^{-0.049}i^{-0.075}$. *This was compared with already existing models and it proved to be a better model to determine Manning-Nigeria coefficient.*

Keywords: Hydrologic model, Manning Coefficient, Nigeria, Runoff coefficients Soils

Introduction
As a watershed begins to accept precipitation, surface vegetation and depressions intercept and retain a portion of that precipitation. Interception, depression storage and soil moisture each contribute to groundwater accretion, which constitutes the basin recharge (Nathanail and Bardos, 2004). Precipitation that does not contribute to basin recharge is direct runoff (Motha and Wigham, 1995). Direct runoff consists of surface runoff (overland flow) and subsurface runoff (interflow), which flows into surface streams. The basin recharge rate is at its maximum at the beginning of a storm, and decreases as the storm progresses (Morita and Yen, 2002).

Basically, a method is needed whereby, for known or assumed conditions within a watershed, the runoff hydrograph resulting from any real or hypothetical storm can be predicted with a high degree of reliability. Such a method must be sufficiently general to allow the determination of the change in system response that would result from proposed water management projects within the watershed. Only with this type of analysis can such projects be designed on a rational basis to produce optimum conditions for a minimum cost.

The concept of integrated watershed runoff coefficient has emerged as a new understanding for the interactions between the surface and subsurface pathways of water. This defines the bidirectional linkage that implies the main rationale for the unity of the two systems. In this regard, surface flow

processes such as channel and overland flow are integrated to subsurface flow process in the unsaturated and saturated ground water flow zones via the dynamic interactions at the ground surface and channel beds. Only with this kind of approach can one determine a standard coefficient for some major soils in a watershed.

The objective of this study was to develop an empirical model that could be used in any part of Nigeria to determine the Manningcoefficient for any particular soil in any given area where construction works are to be carried out.

Methodology

Study area

The permanent site of the Federal University of Technology, Minna is known to have a total land mass of eighteen thousand, nine hundred hectares (18,900 ha) located along kilometre 10, Minna–Bida Road, South–East of Minna, in Bosso Local Government Area of Niger State, Nigeria. It is a horse–shoe shaped stretch of land, lying approximately on longitude of 06^0 28' E and latitude of 09^0 35' N. The entire site is drained by Rivers Gwakodna, Weminate, Grambuku, Legbedna, Tofa and their tributaries. They are all seasonal rivers and the most prominent among them is River Dagga. The most prominent of the features are River Dagga, Garatu Hill and Dan Zaria Dam (Musa, 2003).

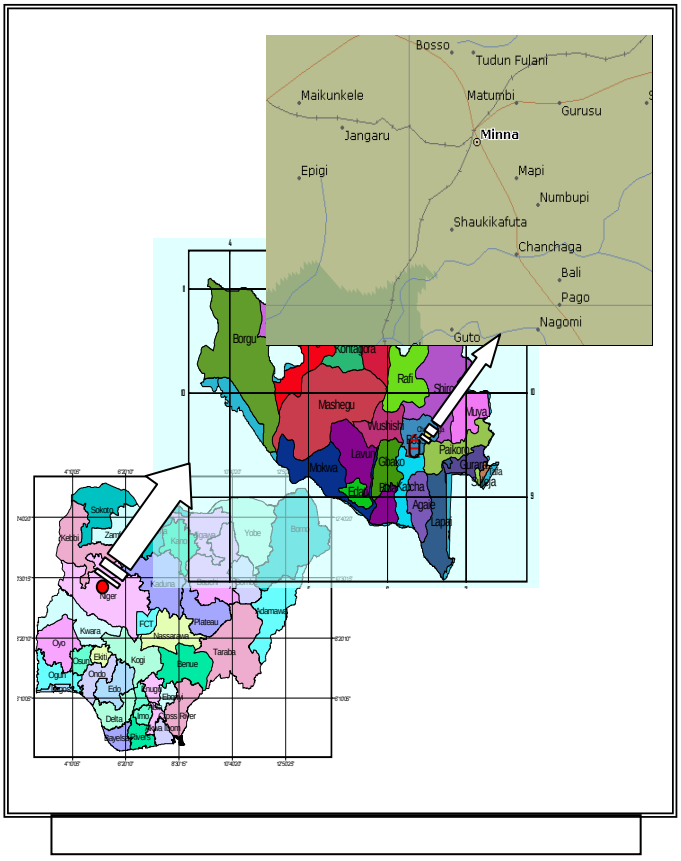

Figure 1: Map of Minna extracted from the maps of Niger State and Nigeria

Runoff plots

A runoff plot was set up to measure surface runoff for the type of soil under controlled conditions. The plot was established directly in the project area with a slope of 9%. The required type of soil

was excavated at 20cm depth from another location and was used to replace the current type of soil existing within the constructed runoff plot. The soil was then ramped to the initial bulk density measured in the field.
Care was taken to avoid study areas with farmlands, rills, soil cracks, or gullies crossing the plot as these could affect the results to be obtained and might not be representativeof the soil type within the area. The gradient/slope from the starting point was 9% and the end point it was 0% which was free of local depressions (this was constructed for each of the runoff plots). During plot construction, the top soil was removed to a depth of 20cm and replaced with fresh soil for which the studies was to be conducted; care was taken to allow the natural conditions to be restored that is even after replacing the top soils some time lag was allowed for the soil to fit into the environment. Grasses were allowed to grow on all the plots to create an undisturbed nature of the soil under consideration. Several runs of the experiments were conducted on the plot to help determine the type of parameters to be considered for the development of the model.

The following parameters were considered for the development of the model: moisture content, length of the plot, slope of the plot, rainfall intensity, and the travel time (time of concentration) of runoff from the starting point of the field to the end point of the same.

Results and Discussion

Based on the numerical model developed by Papadakis and Kazan (1986) from the Navier-Stokes equations, the empirical mathematical model for the determination of the time of concentration was developed for the simulation of sheet flow over the land surface. The overall slope of the land was fixed at 9% with a standard length of 22.9m to mimic the situation explored in the problem statement. The simulated land surface also incorporated micro topography, which allowed various simulations of surface roughness. This model,that is the Papadakis and Kazan (1986) from the Navier-Stokes equations had the following variables of length of the watershed, surface roughness (usually Manning's n), slope of the watershed, and rainfall intensity.

The model is expressed as:

$$T_c = kL^a n^b S^{-y} i^{-z} \qquad \text{Equation 1}$$

where T_c is the time of concentration, L is the watershed length, n is Manning's n, S is the watershed slope, and i is the rainfall intensity. k is a constant and a, b, y, z are exponents. This equation exhibits a linear correlation of the logarithms of the variables involved. It was observed that the antecedent soil moisture had a strong influence on the surface runoff travel time for the season considered. Using the above model, the empirical mathematical method and Crammer's rule were employed to determine the various exponents for the mathematical model for some selected soils in Gidan Kwano area of Minna, Niger State. In developing this equation, the antecedent moisture content for these soils was put into consideration. The model developed for this study is stated below as:

$$T_c = 0.935 L^{0.878} n^{0.324} \theta^{-0.222} S^{-0.049} i^{-0.075} \qquad \text{Equation 2}$$

where
Tc= time of concentration in minutes,
L = watershed length of the study area in meters,
n = Manning's n for some selected soils in Gidan Kwano,
θ = antecedent soil moisture in percent,
S = watershed slope, and
i = rainfall intensity in mm/hr.

From equation 3, making n our subject of formula we have that

$$n^{0.324} = \frac{T_c}{0.938L^{0.878}\theta^{-0.222}S^{-0.049}i^{-0.075}}$$ Equation 3

and on taking the log of both sides, *n* became

$$Logn = \frac{LogT_c - 0.938Log\left(L^{0.878}\theta^{-0.222}S^{-0.049}i^{-0.075}\right)}{0.324}$$ Equation 4

Equation 4 above was used to determine the Manning coefficient for some selected soils (sandy, sandy loam, clay loam, sandy clay and loamy), considered in this study. It was observed that *S* variable had the least influence on the Manning coefficient for those soils considered in the Gidan Kwano area as *S* has the least exponent figure among all variables. Table1presents a summary of the calculated exponents for each of the variables of the model developed.

Table 1: Calculated exponential values of the developed model

Exponents of Parameters	Coefficients
k (constant)	0.938
x (exponent of θ)	-0.222
b (exponent of *n*)	0.324
y (exponent of *S)*	-0.049
z (exponent of *i*)	-0.074

Using the various calculated values of time of concentration for the various equations which were considered not to have to use the already determined values of *n*; it was observed from Table 2 that the time lag equation gave a better result of *n* values for the Gidan Kwano soils of the Federal University of Technology, Minna. It was also observed that the best time of concentration was that determined using the time lag equation which initially could be considered as being too short for water to travel from the most remote area of the plot to the point of collection bearing in mind that the rainfall simulator provided water in all areas of the plot almost at the same time are at a steady rate of flow. From the same table, it was also observed that undisturbed sandy loam and disturbed clay soils had *n* values of 0.00 respectively which implies that no surface runoff occurred and Manning's values may be adopted under these two soil conditions but for the other types and various conditions of soils the values developed can be adopted for soils of similar conditions within Nigeria. The *n* values obtained ranged between 0.00 (for undisturbed sandy loam and disturbed clay soils) and 0.37 for undisturbed sandy soil. When the values of the research work were compared with the figures obtained by Manning, they were very much similar though he did not work on specified soils as presented in this research.

Table 2: Manning's *n* values using various calculated values of time of concentration for the developed mathematical model

S/no	Type of soil	Condition of soil	SCS Tc	FAA Tc	Time Lag Tc
		Undisturbed	3.70	8.87	0.37
1	Sandy	Disturbed	3.48	8.73	0.33
		Undisturbed	1.98	8.41	0.03
2	Sandy Loam	Disturbed	2.69	8.26	0.14
		Undisturbed	0.68	7.64	0.00
3	Clay	Disturbed	1.11	8.17	0.00
		Undisturbed	1.03	7.91	0.25
4	Loam	Disturbed	1.42	7.66	0.22
		Undisturbed	1.82	8.09	0.01
5	Sandy Clay	Disturbed	2.70	8.41	0.15

Where SCS is the Soil Conservation Service, FAA is the Federal Aviation Administration and T_c is the time of concentration.

Conclusion

Itcan be concluded that the values of *n* obtained from the developed model to calculate time of concentration showed that SCS and FAA equations cannot be used to compare with the already existing values of Manning coefficient as the determined ones were seen to be higher. The values of time lag equation values were found to be very close to that of the existing values of Manning coefficient. Thus, this should be used for the design of some basic agricultural water structures to test the durability of the structures over time.

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ARTICLES AND RESEARCH REPORTS ON MATHEMATICS

VARIATIONAL ITERATION METHOD FOR THE SOLUTION OF LINEAR WAVE EQUATION

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Abstract
In this study, He's variational Iteration method is presented as an alternative method of solving the linear wave equation. Some numerical examples are selected to illustrate the effectiveness and accuracy of the method. It is observed that the method is very efficient and rapidly converges as exact solutions are obtained after few iterations.

Keywords: variational iteration method, Lagrange multiplier, differential equations, convergence.

Introduction

The variational iteration method was developed by He (1999, 2000, 2005, 2006a). In recent years a great deal of attention has been devoted to the study of the method. The reliability of the method and the reduction in the size of the computational domain give this method a wide applicability (Gorji-Bandpy et. al. (2007), Ganjavi et. al. (2008) and Onur et. al. (2010)). The present technique requires no restrictive assumptions that are used to handle nonlinear terms. The variational iteration method does not require specific transformation for terms in the equation as required by other techniques (Hussian and Majid (2010)). In this paper, variational iteration method is implemented for finding the exact solutions to linear wave equation.

He's Variational Iteration Method

To illustrate the basic concept of variational iteration method (VIM), we consider the following differential equation.

$$Lu(x,t)+Ru(x,t)+Nu(x,t)=g(x,t) \qquad 2.1$$

Where L is a linear operator, R is the remaining linear operator, N a nonlinear operator and $g(x,t)$ a inhomogeneous term. By the variational iteration method, we can construct a functional as follows:

$$u_{n+1}(x,t)=u_n(x,t)+\int_0^t \lambda(t,s)\left(Lu_n(x,s)+Ru_n(x,s)+N\tilde{u}_n(x,s)-g(x,s)\right)ds \qquad 2.2$$

$n\geq 0$

Where $\lambda(t,s)$ is a general Lagrange multiplier which can be identified optimally via the variational theory (He, (2006b)). The function $\tilde{u}_n$ is a restrictive variation i.e. $\delta\tilde{u}_n=0$. Therefore we first determine the Lagrange multiplier λ, that can be identified optimally via integration by parts. The successive approximation $u_{n+1}(x,t)$; $n\geq 0$ of the solution $u(x,t)$ will be readily obtained upon using the obtained Lagrange multiplier and by using any selective $u_0(x,t)$. The zeroth approximation $u_0(x,t)$ may be selected by any function that satisfies at least two of the prescribed boundary condition (Saeed et. al.(2009)). With λ determined, then several approximation $u_{n+1}(x,t)$ follow immediately. Consequently, the exact solution may be obtained by using $u(x,t)=\lim_{n\to\infty} u_n(x,t)$

Application of Variational Iteration Method

Considering the linear wave equation

$$\frac{\partial^2 u(x,t)}{\partial t^2} - c^2 \frac{\partial^2 u(x,t)}{\partial x^2} = g(x,t) \qquad 3.1$$

Equation (3.1) has a wide range of applications in the fields of science and engineering. By the Variational iteration method, a correct functional for eqn. (3.1) can be constructed as follows:

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t \lambda(t,s)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - c^2 \frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - g(x,s)\right)ds \qquad n \geq 0 \qquad 3.2$$

Its stationary conditions can be obtained as follows

$$\frac{\partial^2 \lambda(t,s)}{\partial s^2} = 0$$

$$1 - \frac{\partial \lambda(t,s)}{\partial s}\bigg|_{t=s} = 0$$

$$\lambda(t,s)\big|_{t=s} = 0$$

The Lagrange multiplier, therefore can be identified as

$$\lambda(t,s) = s - t$$

As a result, the following iteration formula is obtained.

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - c^2 \frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - g(x,s)\right)ds \qquad 3.3$$

Some Numerical Examples

1. Consider the homogeneous one dimensional wave equation

$$u_{tt} - u_{xx} = 0 \qquad 3.4$$

With conditions $u(0,t) = t^2$, $u(x,0) = x^2$ and $u_t(x,0) = 6x$

The following iteration formular is obtain

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - \frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2}\right)ds \qquad 3.5$$

The initial approximation is taken as

$$u_0(x,t) = x^2 + 6xt$$

Using equation (3.3) equation (3.5) yields the following

$$u_1(x,t) = x^2 + 6xt + t^2$$

$$u_2(x,t) = x^2 + 6xt + t^2$$

$$u_3(x,t) = x^2 + 6xt + t^2$$

$$u_n(x,t) = x^2 + 6xt + t^2$$

$u(x,t) = \underset{n\to\infty}{Lim} u_n(x,t)$, hence $u(x,t) = x^2 + 6xt + t^2$

2. Consider inhomogeneous one dimensional wave equation

$$u_{tt} - u_{xx} = t^7 \qquad 3.6$$

With initial conditions $u(x,0) = 2x + \sin x$, $u_t(x,0) = 2x$

The following iteration formular is obtained

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - \frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - s^7 \right) ds \qquad 3.7$$

The initial approximation is taken as

$$u_0(x,t) = 2x + \sin x + 2xt$$

Using the above variation iteration formular equation (3.7) yields

$$u_1(x,t) = 2x + 2xt + \sin x\left(1 - \frac{t^2}{2!}\right) + \frac{t^9}{72}$$

$$u_2(x,t) = 2x + 2xt + \sin x\left(1 - \frac{t^2}{2!} + \frac{t^4}{4!}\right) + \frac{t^9}{72}$$

$$u_3(x,t) = 2x + 2xt + \sin x\left(1 - \frac{t^2}{2!} + \frac{t^4}{4!} - \frac{t^6}{6!}\right) + \frac{t^9}{72}$$

$$u_n(x,t) = 2x + 2xt + \sin x\left(1 - \frac{t^2}{2!} + \frac{t^4}{4!} - \frac{t^6}{6!} + \ldots\ldots + (-1)^n \frac{t^{2n}}{(2n)!}\right) + \frac{t^9}{72}$$

$u(x,t) = \underset{n\to\infty}{Lim} u_n(x,t)$, hence $u(x,t) = 2x + 2xt + \sin x \cos t + \frac{t^9}{72}$

The result obtained is same as obtained by Yehuda and Jacob (2005)

3. Consider inhomogeneous one dimensional wave equation

$$u_{tt} - 9u_{xx} = e^x - e^{-x} \qquad 3.8$$

With initial conditions $u(x,0) = x$, $u_t(x,0) = \sin x$

The following iteration formular is obtain

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - 9\frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - e^x + e^{-x} \right) ds \qquad 3.9$$

The initial approximation is taken as

$u_0(x,t) = x + t\sin x$

Using the above variation iteration formular equation (3.9) yields

$$u_1(x,t) = x + \sin x\left(t - \frac{3t^3}{2}\right) + e^x\left(\frac{t^2}{2}\right) - e^{-x}\left(\frac{t^2}{2}\right)$$

$$u_2(x,t) = x + \sin x\left(t - \frac{3t^3}{2} + \frac{27t^5}{40}\right) + e^x\left(\frac{t^2}{2} + \frac{3t^4}{8}\right) - e^{-x}\left(\frac{t^2}{2} + \frac{3t^4}{8}\right)$$

$$u_3(x,t) = x + \sin x\left(t - \frac{3t^3}{2} + \frac{27t^5}{40} - \frac{81t^7}{560}\right) + e^x\left(\frac{t^2}{2} + \frac{3t^4}{8} + \frac{9t^6}{80}\right) - e^{-x}\left(\frac{t^2}{2} + \frac{3t^4}{8} + \frac{9t^6}{80}\right)$$

$$u_n(x,t) = x + \sin x\left(t - \frac{3t^3}{2} + \frac{27t^5}{40} - \frac{81t^7}{560} + \ldots\right) + e^x\left(\frac{t^2}{2} + \frac{3t^4}{8} + \frac{9t^6}{80} + ..\right) - e^{-x}\left(\frac{t^2}{2} + \frac{3t^4}{8} + \frac{9t^6}{80} + ..\right)$$

$u(x,t) = \underset{n\to\infty}{Lim} u_n(x,t)$, hence $u(x,t) = x + \frac{\sin x \sin 3t}{3} + \frac{1}{9}\left(e^x - e^{-x}\right)(\cosh 3t - 1)$

4. Consider inhomogeneous one dimensional wave equation

$$u_{tt} - 4u_{xx} = 6t \qquad 3.10$$

With conditions, $u(x,0) = x$ and $u_t(x,0) = 0$

The following iteration formular is obtain

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - 4\frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - 6s\right)ds \qquad 3.11$$

The initial approximation is taken as

$u_0(x,t) = x$

Using the above variation iteration formular equation (3.11) yields

$$u_1(x,t) = x + t^3$$
$$u_2(x,t) = x + t^3$$
$$u_3(x,t) = x + t^3$$
$$u_n(x,t) = x + t^3$$

$u(x,t) = \underset{n\to\infty}{Lim} u_n(x,t)$, hence $u(x,t) = x + t^3$

5. Consider inhomogeneous one dimensional wave equation

$$u_{tt} - u_{xx} = xt \qquad 3.12$$

With initial conditions $u(x,0) = 0$, $u_t(x,0) = e^x$

The following iteration formular is obtained

$$u_{n+1}(x,t) = u_n(x,t) + \int_0^t (s-t)\left(\frac{\partial^2 u_n(x,s)}{\partial s^2} - \frac{\partial^2 \tilde{u}_n(x,s)}{\partial x^2} - xs \right) ds \qquad 3.13$$

The initial approximation is taken as

$u_0(x,t) = t\,e^x$

Using the above variation iteration formular equation (3.13) yields

$$u_1(x,t) = e^x\left(t + \frac{t^3}{3!} \right) + \frac{1}{6}xt^3$$

$$u_2(x,t) = e^x\left(t + \frac{t^3}{3!} + \frac{t^5}{5!} \right) + \frac{1}{6}xt^3$$

$$u_3(x,t) = e^x\left(t + \frac{t^3}{3!} + \frac{t^5}{5!} + \frac{t^7}{7!} \right) + \frac{1}{6}xt^3$$

$$u_n(x,t) = e^x\left(t + \frac{t^3}{3!} + \frac{t^5}{5!} + \frac{t^7}{7!} + ... + \frac{t^{2n+1}}{(2n+1)!} \right) + \frac{1}{6}xt^3$$

$u(x,t) = \underset{n\to\infty}{Lim}\, u_n(x,t)$, hence $u(x,t) = e^x \sinh t + \frac{1}{6}xt^3$

Conclusion

The variational iteration method is employed in this work to obtain exact solutions to the linear wave equation. The variational iteration method reduces the size of calculations and do not require large computer memory and discretization of variable t as the exact solutions are obtained by fewer iterations. The initial approximations can be arbitrary chosen with unknown constants. It can be concluded that the variational iteration method is very powerful tool for solving linear and nonlinear initial value problem (IVPs). For computations in this paper, maple package was employed.

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ARTICLES AND RESEARCH REPORTS ON EDUCATION

AN INVESTIATION OF STRATEGIES TOWARDS IMPROVING INFORMAL APPRENTICESHIP TRAINING PROGRAMME IN WOODWORK TRADES IN NIGER STATE

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Abstract
This study was designed at improving informal apprenticeship training programme in woodwork trades. A survey designed was adopted, the respondents of the study consisted of 120 masters craftsmen and 58 apprentices. The total population was 178. A structured questionnaire was pilot tested on 80 respondents who are not part of the population for the study, after being subjected to face validation by four experts. The reliability coefficient of the instrument was yielded tobe 0.86 using cronbach Alpha. Three research questions and 2 hypotheses were tested at 0.05 level of significance guided the study. The study revealed among others that the training programme is not back-up with well integrated element of theoretical knowledge about the field concerned, lack of adequate training in facility and non-accreditation of the programme in order to maintain standards. Based on theses findings, the study recommended among others that, Seminars, workshop and evening part-time programme should be organized for mastercraftsmen and the programme should accredited. Labour and productivity ministry should solicit for funds/materials from international organizations, government agencies and philanthropist for the training of apprentices.

Keywards: Apprenticeship, woodwork, Trades, craftsmen, Training programme.

Introduction
Informal education refers to indigenous or traditional education. It is the process by which every society attempts to preserve and upgrade the accumulated knowledge, skills and attitudes in its cultural setting and heritage to continuously foster the well-being of mankind. House and Parramatta (2009) noted that informal education is non-credential based. However, it contains recognizable and valued knowledge, skills and attitudes which are essential for meaningful role playing in the society. Informal education begins at birth and it is long term and multivariate in nature. When a child is born, his experiences are confined to what he learns from the parents and the environment as a member of a cultural group (Esu & Junaid, 2008)

According to Mayer (2003), apprenticeship is a contractual agreement undertaken by the master craftsman and the apprentice through which the apprentice is trained for a prescribed work process through practical experience under the supervision of the master craftsmen. It is a form of work price learning which enables the apprentice to have on-the-job training. (Ritta 2003, Singh, 2000). Hence, Okoro (2009) point out that apprenticeship was the first method prevalent in Nigeria before the establishment of vocational and technical institutions. He stated further that even today, the apprenticeship programme produces the bulk of skilled and semi-skilled work force in the country. Apprenticeship varied from district to district and from craft to craft (Mohammed, 2004).

Oluseun (2002) describes woodwork technology as one of the most prominent early technical occupations in the history of human civilization, especially in the areas of art work, design, hand tools, tools for farming and hunting, ritualistic objects for worships, etc. woodwork technology is popular technical occupation practiced in virtually all parts of the country in different forms.

Continuing education is crucial to the acquisition of essential life skills that enable individuals to live in literacy society. Christopher and Grubb (2006) observed that continuing education applies not only to formal sector individuals, but also to small and macro-enterprises and rural and urban informal sector, to improve their skills, products services to the society and to enhance their competitiveness. Continuing education is increasingly been seen as a productive of life and overall development growth, and it is an improvement for out of school youth and non-literate adults (Christopher & Grubb 2006 UNESCO, 2008).

Niger state is located in the North central geo-political zone of Nigeria. 90% of the indigenes are predominantly farmers, Blacksmiths, brass; copper works and bead manufacturing were practiced in Bida area of the state long before the nineteenth century (Osuala, 2004). The local smith forged spears and arrows which were used for hunting other farm implements and household tools were made from locally mined iron. So many youths were trained in blacksmithing and foundry works. The emphasis later shifted to other trades such as carpentry, foundry, forging electrical works, fitting and machining of mechanical companies and a host of others. Majority of the furniture craft practitioners were found in urban towns, they produce furniture to cater for individual domestic needs in other to enhance good quality of goods by these practitioners, a research of this nature is necessary in order to help diagnose these trades to a greater height.

Statement of the Problem

Apprenticeship system constitutes principally vocational training, which is concerned with securing skills for an occupation. Like any unorganized system, the Nigerian information apprenticeship training programme has the problem of imparting to the learner's the theory and the principles underlying what they are learning. Mayer (2003) notes that the training is neither structured nor systematic. He observed further that during the training, the apprentice copies whatever his master does and in so doing, a good amount of unsatisfactory practices are picked up.

Most workshops do not have the required tools and machines. They are able to carry out repairs and production due to adaptation to tools and machinery. The educational level of the master craftsmen and apprentices is very low. In fact majority of them are primary leaving certificate holders. The occupational success of an individual as well is upgrading of his or her technical skills are closely linked to the possession of basic education. Eze (2005) suggests that some element of formal training in the form of part-time evening classes could enhance the learning process for those in the information sector. Based on some of the deficiencies associated with the information apprenticeship training as highlighted above, the outcome of the study will assist in improving the programme.

Purpose of the Study

The purpose of the study is to determine:

(i) Ways of providing the facilities needed for improving the training of apprentices in woodworks trades
(ii) Ways of accrediting informal apprenticeship training programme in woodwork trades.
(iii) Suitable strategies for conducting educational programme for master craftsmen.

Research Questions

(i) What are ways could facilities be provided in order to improve the training of the apprentices in woodwork trades?
(ii) What are the ways for accrediting informal apprenticeship training programme in woodwork trades?
(iii) What are the suitable strategies required for conducting continuing education programme for master craftsmen.

Hypotheses

Ho_1 There is no significant difference in the mean responses of master craftsmen and the journeymen on ways through which facilities could be provided for the training of apprentices in woodwork trades

Ho_2 There is no significant difference in the mean responses of master craftsmen and the journeymen as regard accreditation of the training programme.

Methodology

The study adopted survey research design. The study was conducted in seven educational zones in Niger state namely; Bida, Borgu, Minna, Rijau, Kutigi, Kontagora, Lapai and Suleja. The population for the study focused on six urban towns. The choice of these towns was based on their cosmopolitan nature, which make them very attractive to young people migrating into them. A list of woodwork trades and crafts that are registered with the Ministry of trade, commerce and Industries in these towns were obtained. The entire population for the study comprises 640 master craftsmen and apprentices.(Niger state Ministry of Trades, Commerce and Industries 2004). Face validation of the instrument was carried out by three experts in Industrial & Technology Education Department of the Federal University of Technology, Minna, Niger State, Nigeria.The reliability of the instrument was established using the Cronbach Alpha (α) formula. The choice of Cronbach Alpha was based on the fact that, it provides for a more stable measure of homogeneity (Ezeh 2005). Pilot testing of the instrument was carried out in Nassarawa State with 150 respondents comprising of 100 master craftsmen and 50 apprentices. This forms 58.6% of the total respondents. The result of the reliability coefficient reanged from 0.88 to 0.98 while the final reliability coefficient was 0.86.The questionnaire was administered personally by the researchers with six (6) research assistants. This was to ensure prompt and timely return of the questionnaire and to avoid questionnaire mortality. The return rate was 100%.The data obtained for the study was analyzed using percentages, means, standard deviations and t-test statistics. In taking decision for the research questions, any item with mean of 3.50 and above was considered ass agreed, while any item with the mean of less than 3.50 was considered as disagreed. For the hypothesis, if the t-cal is more than the t-table, the null hypothesis is rejected but if the t-cal is less than the table, the null hypothesis were accepted.

Research question 1

In what ways could facilities be provided in order to improve the training of the apprentices in woodwork trades?

Table 1: Means and standard deviation of respondents on ways facilities could be provided for the training of apprentices in woodworks trades

S/No	Ways	$\bar{X}$	SD	Remarks
1	Central equipment borrowing center.	4.62	0.48	Agreed
2	Linkage with nearby technical college or polytechnics for sharing facilities	3.03	1.31	Agreed
3	Support from non-governmental organization (NGO')	4.78	0.41	Agreed
4	Grant from National Directorate of Employment (NDE) of employment/ tools acquisition	4.50	0.50	Agreed

5	Support from philanthropist/philanthropies for tool acquisition	4.51	0.50	Agreed
6	Support from industrial training fund	4.92	0.24	Agreed
7	Support from machine tools companies	4.92	0.26	Agreed
8	Support from science and equipment center for borrowing tools.	4.53	0.52	Agreed
9	Provision of soft loan to trainers by ministry of labour and productivity to procure necessary tools' materials and equipment.	4.55	0.49	Agreed

Table 1 shows that 8 items have their means scores ranked above the cutoff point of 3.50 only one item which mean score ranked below the cut-off point of 3.50, this indicates that some of the respondents are not in agreement on sharing of facilities with near by technical colleges or polytechnic. The least standard deviation of 0.24 as shown in the table, is an indication that majority of the respondents agreed to the fact that support from industrial training fund (ITF) for tools and equipment will assist in improving the training of apprentices in Woodwork trade.

Research Question 2

What are the ways for accrediting informal apprenticeship training programme in woodwork trades?

Table 2: Means and standard deviations of the respondents on ways for accrediting informal apprenticeship training programme in woodwork trades

S/No	Ways	$\overline{X}$	SD	Remarks
10	Examining the availability of adequate tool box used by the trainees	4.42	0.06	Agreed
11	Ensuring a well organized and properly structured training programmes by labour and productivity ministry.	4.37	0.53	Agreed
12	Regular supervision of trainees by the trainers in every activity	4.42	0.84	Agreed
13	NABTEB involvement in conducting a standardized practical examination for trainees at the end of their training programme for certification	3.17	1.39	Agreed
14	Preparing a comprehensive training guide for the trainers by labour and productivity ministry so as to attain the programme objectives.	4.39	0.63	Agreed
15	Involvement of resource personnel for expert advice.	4.49	0.53	Agreed
16	Affiliating the programmes to NDE	4.37	0.73	Agreed
17	Stipulation of age limit for new entrants is 15 years and above.	3.26	1.39	Agreed
18	Training duration for each trade should be 3 years	3.15	1.31	Agreed
19	Verifying whether the recruitment of new entrants is done based on the availability of workshops tools and equipment.	4.43	0.59	Agreed

From Table 2, 7 items have their mean scores ranked above the cut-off point of 3.50, while 3 items have their mean scores ranked below the cut-off point. This is an indication that some of the respondents are not in Support of items 13,17 and 18 respectively. This could also mean that some of the respondents are not in Support for the inclusion of these three items as way for accrediting informal apprenticeship training programme in woodwork trades.

However, items 11 and 1*5* received the least standard deviation of *0.53* each. Consequently this is evidence that greater number of respondents agreed on ensuring a well organized and properly structured training programme by labour and productivity ministry and also involvement of resource personnel for expert advice as ways for accrediting informal apprenticeship training programme in woodwork trades.

Research Question 3

What are the suitable strategies required for conducting continuing education programme for master craftsmen?

Table 3: Respondents means and standard deviation on suitable strategies required for conducting continuing education programme for master craftsmen

S/No	Ways	$\bar{X}$	SD	Remarks
20	Organizing seminar by experts from colleges of technology, polytechnic and the universities.	4.52	0.5 1	Agreed
21	Organizing evening classes for master craftsmen and journeymen by instructors from technical colleges and colleges of technology	4.42	0.66	Agreed
22	Introduction of field trips to other enterprises by NDE, labour and productivity ministry	4.5 1	0.05	Agreed
23	Introduction of videotaped CD/CD Rom programme by ministry of information and national orientation.	*4.55*	0.49	Agreed
24	Mass media and broadcasting programmes by ministry of information and national orientation.	4.45	*0.55*	Agreed
25	Conference type group study in each of the urban towns by ministry of labour and productivity, NDE and ITF.	4.23	0.57	Agreed

Table 3 indicated that all the 7 items have their mean scores ranked above the cut-off point of 3.50 with the least standard deviation of 0.49. This indicates that greater number of respondents agreed on the introduction of field trips to other enterprise by NDE;labour and productivity ministry will be suitable strategies for conducting continuing education programme for master craftsmen.

Hypothesis 1

Groups	No of Subjects	Mean	S.D	df	p-level	t-calculated	Table –t	Remark
Craftsmen	120	23.69	5.51	138	0.05	0.83	1.98	Significant
Apprentices	58	23.90	5.13					

$H0_1$: There is no significant difference in the mean responses of master craftsmen and the apprentices on ways which facilities could be provided for the training of apprentices in woodwork trades.

Table 4: t-test comparison of mean responses of master craftsmen and the apprentices as regards ways through which facilities could be provided for the training of apprentices in woodwork trades

The result presented in Table 4 shows that, craftsmen obtained a mean score of 23.69 and standard deviation of 5.51. The apprentices obtained a mean score of 23.90 and standard deviation of 5.13. The table also revealed that, the calculated t-value obtained was 0.83 while the table-t value at 0.5 level of significance was 1.98. Since the calculated t-value of 0.83 is not greater than the t-value of

1.98, then there is no significant difference between craftsmen and apprentices. This hypothesis is thereby upheld, despite the fact that there is difference in the mean score of the craftsmen (23.69) and that of apprentices (23.90). This hypothesis is upheld because, the difference in craftsmen and apprentices is not significant.

Groups	No of Subjects	Mean	S.D	df	p-level	t-calculated	Table –t	Remark
Craftsmen	120	23.69	5.51	138	0.05	0.83	1.98	Significant
Apprentices	58	23.90	5.13					

Hypothesis 2

Ho_2 There is no significant difference in the mean responses of master craftsmen and the journeymen as regard accreditation of informal apprenticeship training programme in woodwork trades.

Table 5: T-test analysis of the mean responses of master craftsmen and apprentices on accreditation of informal apprenticeship training programme in woodwork

The result presented in table 5 shows that, craftsmen obtained a mean score of 23.26 and standard deviation of 5.86. The apprentices obtained a mean score of 25.01 and standard deviation of 3.64. the table also revealed that, the calculated t-value at 0.05 level of significance was 1.98 since the calculated t-value of 0.08 is less than the table-t value of 1.98, then there is no significant difference between craftsmen and apprentices. This hypothesis is thereby upheld. Even though there is difference in the mean score of the Craftsmen (mean score 23.26) and apprentices (mean score 25.01), the difference was not statistically significant.

Discussion of Findings

Based on the data collected and analysed, the following principal findings were made.

1. The training programme is not backed up with related theoretical contents. Based on this fact's, the contents for improving the training programme for the trades used in the study were identified by the respondents.
2. Lack of adequate training facilities.
3. No financial assistance to master craftsmen and the apprentices by the government in terms of loan to procure tools and equipment.
4. No assistance from NGOs and other philanthropists/philanthropies for tools and equipment.
5. Competencies and skills acquired by the trainees are not back up with relevant and recognized certificate.
6. The training programme is not accredited.
7. No statutory "Body" appointed by the government or any other agencies to oversee the activities of the training programme.
8. No consultancy service(s) rendered to master craftsmen and the apprentices by any government agency/specialist in order to broaden their knowledge.

Conclusion

On the basis of the findings, it can be agreed that even though informal apprenticeship training has contributed in producing bulk of skilled and semi skilled work force in Niger state, yet the training programme is neither structured nor systematic.

Evidence from the study revealed that majority of' master craftsmen and the journeymen belong to low socio-economic bracket and therefore, cannot afford to procure modern tools and equipment. Though they identified various ways which facilities could be provided for the training of apprentices in these trades?

Financing from the study also reveals ways of accrediting informal apprenticeship training programme and suitable strategies required for conducting continuing education programme for master craftsmen. Therefore, improving informal apprenticeship in woodwork trades will bring about increased patronage in the quality of product produced by these woodwork practitioners.

Recommendations

The following recommendations are made based on the findings of the study.

(i) Ministry of Labour and Productivity should develop a training guide for all vocational and technical trades.
(ii) Re-introduction of mobile workshops to assist master trainers for tools borrowing.
(iii) Government should assist master craftsmen and the journeymen with soft loan to procure tools and equipment.
(iv) Ministry of labour and productivity should solicit for financial assistance from philanthropists, local or international organizations, example of some of these organizations are; UNESCO, UNICEF, UNDP, WORLD BANK etc...Theseorganizations are highly spirited with voluntary donations viable for improving the training programme.
(v) Operators of informal apprenticeship training programme should be supervised by labour and productivity ministry of the state.
(vi) The training programme should be affiliated to NDE& YES.
(vii) The minimum age of new entrants should be clearly stated by labour and productivity ministry.
(viii) Training duration for each trade should be clearly stated by labour and productivity ministry.
(ix) The number of apprentices taken by master craftsmen should be commensurate to the size of his workshop. No master trainers should be allowed to take more apprentices other than he can properly train.
(x) Ministry of labour and productivity should organize continuing education programme for master craftsmen and the journeymen.

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JOB INVOLVEMENT AND ORGANIZATIONAL COMMITMENT AS DETERMINANTS OF JOB PERFORMANCE AMONG EDUCATIONAL RESOURCE CENTRE PERSONNEL IN OYO STATE, NIGERIA

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Abstract
The study investigated the relationship among job involvement, organizational commitment and job performance of the educational resource centre personnel in Oyo state, Nigeria. Seventy-eight educational resource centre personnel were purposively sampled in all the thirty-three local government areas of Oyo state made up of 25 males and 53 females. The instrument used for collecting data for this study was a researchers' developed questionnaire which contained structured items that included job involvement, organizational commitment and job performance scales. Three null hypotheses were tested at 0.05 level of significance. Results showed that job involvement and age were correlated with job performance (r=.106;r=.147). The implications of these findings for educational managers, head teachers and ministries of education were discussed. It was suggested that to develop a more job involving, and organizationally committed employees systems, educational resource centre should be more stimulating and challenging to the personnel by providing required facilities for efficient performance

Introduction
The concepts of job involvement and organizational commitment have received increased attention in recent times due to their importance for understanding and predicting turnover and absenteeism (Huselid & Day, 1991). It is however needed to be pointed out that relatively limited research exists on the predictive power of job involvement and organizational commitment on job performance (Mathieu & Zajac, 1990; Meyer, Paunonen, Gellatly, Goffin & Jackson, 1989).

Meyer and Herscovitch (2001) defined commitment as a force that binds an individual to a course of action that is of relevance to a particular target. Commitment is a more responsive approach by an organization. Organizational commitment, therefore, is defined as the strength of individual's identification with and involvement in a particular organization'. It can be assumed that greater organizational commitment increases job satisfaction which in return enhances performance of the individual. Meyer and Allen (1997) define the general concept of organizational commitment as a psychological link between the employee and his or her organization that makes it less likely that the employee will voluntarily leave the organization. More recently, several researchers have categorized the concept of organizational commitment into three major themes: affective, normative, and continuance commitment (Fields, 2002; Laschinger, Finegan, Shamian, & Casier, 2000; Manion, 2004; Meyer & Allen, 1997). Affective commitment is the "employee's liking for an organization, and related to involvement with the organization" (Fields, 2002): normative commitment designates the feeling of obligation of needing to continue employment; and continuance commitment is created by high costs associated with leaving the organization, and creates a feeling of needing to continue employment (Van de Hooff & de Ridder, 2004).

Clearly, research literature is paying increasing attention to the concept of commitment as managers and organization analysts are continually seeking ways of increasing employee retention and

performance. Interest in organizational commitment has therefore, been stimulated largely because it evident that commitment reduces turnover and increases performance.

Job performance can be defined as 'ability to perform effectively which requires understanding of a complete and up-to-date job description of a position, and job performance requirement and standards that are expected to meet'. It means a work performance in terms of quantity and quality expected from each employee. A number of factors have been identified to predict job performance. These factors include job involvement and organizational commitment. In this study, an individual's performance is assessed in terms of effort, either day to day, or when there are extraordinary circumstances. What then is job involvement? Job involvement is a popular construct in psychological research. Job involvement has emerged an important variable in organizational research. It has drawn the attention of management scientists and organizational psychologists. This variable is being studied with different perspective in the organization. It has a great importance and significance in organizational development. This is due to its importance in predicting such job outcomes as job performance turnover and absenteeism (Keller, 1997; Huselid & Day, 1991). Job involvement has been defined in various ways. The definitions have ranged from the degree to which one is engaged in one's present job, to the degree to which one is engaged in carrying out the specific tasks in the present job environment, to the degree of importance that work plays in one's life. The latter definition emphasizes the centrality of job in people's life and it is from this conceptualization that the term work centrality has been coined. Job involvement and organizational commitment had been found to interactively predict turnover and absenteeism (Brown, 1996; Huselid & Day, 1991). The interaction hypothesis anchored on the belief that worker who is both involved in his job and committed to his organization will tend to stay with his organization and be committed to it.

Though studies have been carried out on the use of educational resource centres regarding the level and the perception of teachers towards the programmes and services provided, none has focused on job involvement and organizational commitment of resource centres' personnel in Nigeria. This study can help in bridging this gap. It is hoped that its findings will help educational resource centre administrators make materials more useful, accessible and relevant to all users.

Consequence upon the above, there is need to ask a question on what determines educational resource centre personnel performance? An individual in a work setting experiences simultaneously varying degree of commitment toward several aspects of working life, such as the employing organization, the job or task, and personal career. Performance, therefore, may be better understood as a function of all such commitments combined, rather than as a function of one commitment type of another separately. Hence, an educational resource centre personnel may perform better if he is involved in decision making and/or if he devotes more personal time to work related activities such as making materials more useful, accessible and relevant to the users and also stay beyond the required working hours. Also, if an employee is loyal to his duty and not willing to leave his job, he will tend to perform better. This is because he will try as much as possible to contribute his own efforts to the success of his organization.

Age is one of the factors affecting job performance. Different studies conducted show that older workers are more satisfied and performed well. Kose (1985) found a significant relationship between the age and job performance; age and professional experience (Hamshari, 1986) educational level (Hamshari, 1986; Well-Maker, 1985). In spite of these positive results from age, little or no research has been carried out on age and job performance of education resource centre personnel.

Statement of the Problem

Educational resource centre provide resources for knowledge acquisition, recreation, personal interest and interpersonal relationship for all categories of users. The willingness of the educational resource centre personnel to provide the available learning resources is being continually undermined and called into question by individual commitment. In spite of the fact that educational resource centre plays significant roles in attainment of the goals of an academic institution has been observed that various educational resource centres in Oyo state are not providing services as expected of them. In the light of this, this study examined the influence and interactive effects of job involvement and organizational commitment on the performance of educational resource centres' personnel in Oyo state.

Purpose of Study

The purpose of study was to investigate job involvement and organization commitment as determinants of job performance of educational resource centre personnel.

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significant in the study:

1. There will be no significant relationship between job involvement and job performance of educational resource centre personnel.
2. There will be no significant relationship between organizational commitment and job performance of educational resource centre personnel.
3. There will be no significant relationship between age and job performance of educational resource centre personnel.

Methodology

The research design adopted for this study was survey research method in which questionnaire were utilized in collecting data on the variables investigated - job involvement, organizational commitment, age and job performance.

All the thirty-three educational resource centres' personnel in the service of Oyo State government, made up of 25 males and 53 females, in Oyo State were purposively sampled for the study. The participants' educational qualifications run thus, 34.55% NCE, while 61.36% had University degree, and 4.09% had certificates in Library Studies. Their levels of experience range from 5 to 18 years.

The instrument used for collecting data for this study was a questionnaire. It is made up of two sections. The first section sought demographic data while the second section contained structured items that were developed through extensive review of literature which included job involvement scale developed by Lodahl and Kejner (1965) for assessing the importance of job in the life of each participant; organizational commitment scale by Meyer and Allen (1991) to assess the commitment of an employee to its employing organization; and job performance with Employee's Performance Rating Scale (EPRS).

Job involvement was measured with six items from the Lodahl and Kejner (1965) scale with correlation coefficient alpha of 0.78 selected on the psychometric analysis of Hunt, Osborn, and Marthin (1981). These items focused on one's involvement in the present job and the importance of work in general. A 4–point response scale, ranging from strongly disagree (1) to strongly agree (4) was used. The instrument had also been used by Adedapo (2001), in predicting the performance of scientists and engineers. Organizational commitment was measured by organizational commitment scale developed by Meyer and Allen (1991). It is a scale designed to assess the extent of one's commitment to an employing organization. The scale consisted of five items with coefficient alpha of 0.79. Job performance was measured by Employee's Performance Rating Scale (EPRS) that consisted of 16–item. It has a reliability correlation co-efficient of 0.79 obtained from a test-retest of

sample of subjects carried out within an interval of eight (8) weeks. The response anchor ranges from very poor (1) to very good (4).

Copies of the questionnaire on completion were coded and entered with the aid of computer. Frequency tables were generated for the variables tested. Also, multiple linear regressions were applied to test for statistical association between the dependent and independent variables (job involvement, organizational commitment, age and job performance). For all the statistical analysis, P.value was set at 0.05 significant level.

Results

Source of Variance	SS	dF	MS	F	P
Regression	735.505	4	147.101		
Residual	11258.604	73	52.610	2.796	S
Total	11994.109	77			

Table 1: Summary of ANOVA of Correlation of Variables to Predict Job Performance among Educational Resource Centres' Personnel.

Analysis of Variance

Multiple R.	=	.248
R Square	=	.061
Adjusted R^2	=	.039
Standard Error of estimate	=	7.25

Table 1 shows that the use of independent variables to predict job performance among educational resource centres' personnel in Oyo State yielded a coefficient of multiple regression (R) of .248, multiple correlation square (R) of .061. The table also shows that the analysis of variable of the multiple regression data yielded an F-ratio of 2.796 (Significant at 0.05 level). From this, it can be concluded that there is significant relationship between the independent variables and job performance.

Table 2: Testing the significance of regression weights on relative contribution of independent variables to the prediction

S/N	Variable Description	B	SEB	BETA	T	Sig. T
	Constant	50.219	5.939		8.455	.000
1.	Age	.334	.142	.347	2.352	.020
2.	Job Involvement	.373	.142	.177	2.631	.009
3.	Organizational Commitment	-199	.138	-.097	-1.451	.148
4.	Years of Experience	-.207	.132	-.230	-1.564	.119

Table 2 shows the relative contribution of the independent variable to performance. The standardize regression weight (B), the Standard Error of Estimate (SEB), the Beta, the t-ratio associated with two variables (age & job involvement) is significant at the 0.05 level. The table shows that organizational commitment (B = -.097) and years of experience (B= -.230) have low contribution to job performance, while variables age (0.20) and job involvement (0.009) have significant contribution to job performance.

Table 3: Mean, standard deviation and the correlation matrix of the predictor variales and job performance

S/N	Variables	Job Performance	Age	Job Involvement	Organizational Commitment	Years of Experience
1	Job Performance	1				
2	Age	0.106	1			
3	Job Involvement	0.147	-0.175	1		
4	Organizational Commitment	-0.075	0.002	0.061	1	
5	Years of Experience	0.048	0.892	-0.154	-0.021	1
	Mean	65.84	37.79	19.7	18.49	12.03
	Standard Deviation	7.4	7.69	3.52	3.6	8.25

N = 78, Correlations greater than $\pm$ .1946 are significant at P$<$ .05.

From Table 3, it is observed that correlation (r = 0.147, p $>$ 0.05) was not established between job performance and job involvement. Hence, the hypothesis one which states that there will be no significant relationship between job involvement and job performance among educational resource centre personnel was hereby accepted. Hypothesis 2, which states that there will be no significant relationship between organizational commitment and job performance among educational resource centre personnel was accepted since no significant correlation exist between the variables (r = -.075 p $>$0.05).

Discussion

The first hypothesis, which states that there will be no significant relationship between job involvement and job performance of educational resource centre personnel, was rejected. The result showed that there was significant relationship between job involvement and job performance among educational resource centre personnel.

The result agrees to the findings of Geschman (1977) who found out that job involvement contributes to greater effort and performance. Results found by Rotenberry and Moberg (2007) indicated that employees that were more involved in their job were good performers as compared to the employees who were not involved. Also, Baugh and Roberts (1994) found out that committed

employees had high expectations of their performance and therefore performed better. The findings contradict the result of Akanbi (1986), who reported that job involvement did not contribute significantly to the explanation of job performance variations of teachers in a survey conducted using Kwara State Teachers' Training College of Nigeria.

The second hypothesis, which states that there will be no significant relationship between organizational commitment and job performance, was accepted. The result obtained from the multiple regression analysis showed that there was no significant relationship between organizational commitment and job performance. The result of the findings agrees to those of Steers (1977) who found out that workers performance not to relate to organizational commitment. However, the result is not in support of Mowday, Steers and Porter (1979) who reported that the role of personal characteristics and experiences that a person bring to an organization can predict individual commitment to the organization. Plausible reasons why performance and commitment may not be related might be due to factors which include the seriousness with which supervisors value the appraisal process, the value of job performance by resource centre and the amount of employee control over outcome.

The third hypothesis, which states that there will be no significant relationship between age and job performance among educational resource centre personnel, was rejected. The result showed that there was significant relationship between age and job performance among educational resource centre personnel. The result of significant relationship agrees to different studies conducted that found out a meaningful relationship between the age and job performance (Kose, 1985; Hamshari, 1986). The researchers were unable to locate a study that reported no significant relationship between age and job performance among the resource centre personnel. There are however other studies that reported no significant relationship between age and organizational commitment. Irving, Coleman and Cooper (1997) found that age was not related to organizational commitment. Also, Meyer and Allen (1997) reported that age was not correlated with organizational commitment. One possible explanation for this findings is that age might be correlated with job performance by postulating that it serves as proxy for seniority.

Conclusion and Recommendations

The results of this study have revealed that out of the three independent variables, job involvement and age have stronger relationship with job performance. Organizational commitment though, has relationship with job performance, its effect was low. However, since the study focused only on three variables out of the many variables influencing job performance further studies need to be carried out to include more variables influencing job performance. The sample used in the study is limited to Oyo State. For more generalizable result effort should be made to extend it to a larger population. Representation may be drawn to include a larger sample to cover more states.

Furthermore, realizing that job involvement and organizational commitment have important implications for job performance, educational managers, state and federal ministries of education in Nigeria need to develop a more job involving, and organizationally committed employees. This can be done through the provision of incentives and opportunity for on-the-job training, and prompt payment of employees' salaries. Since recognition is associated with identification, involvement and loyalty, schools should be made stimulating enough and challenging to the personnel by providing required facilities for efficient performance.

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IMPACT OF VIDEO INSTRUCTIONAL PACKAGE ON IMPROVING THE PARBOILING AND MILLING PRACTICES OF LOCALLY PROCESSED RICE IN KWARA STATE, NIGERIA

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Abstract
This study examined the influence of video instructional package on rice processing in rice production communities of Kwara State, Nigeria. Two hundred and fifty (250) adult rice farmers were purposively sampled from five communities in Kwara State. The treatment administered was a video instructional package in rice processing which was packaged and validated by West Africa Rice Development Association (WARDA), Republic of Benin. Oral interview was the test instrument used and the findings of the study revealed that 69.20%, 70.40% and 69.60% of the respondents responded that the parboiling, milling and cleanliness qualities of rice processed after watching the video package were improved respectively. Video instruction is therefore recommended as a means of informing and training rice farmers on rice processing with a view to improving the quality of locally processed rice.

Keywords: milling, parboiling, rice processing, video instructional package

Introduction

Rice is the world's most extensively cultivated crop. It accounts for about 60% of the world's total crop production. Japan, China, India, Phillipines and Indonesia are regarded as the world's largest rice producing countries with Nigeria coming next to Egypt on Africa's rice production table (Osungade, 2004). Nigeria is regarded as the largest producer of rice in West Africa (Osungade, 2004; WARDA, 2005), yet the country still import rice because urban dwellers prefer it to locally produced ones, a situation that makes demand for imported rice to be high at the expense of local product.

Consumers of rice in the country complain of low quality which arises as a result of poor processing. Imported rice takes five years after production before being consumed in Africa and would have lost its nutrients before consumption (WARDA, 2005). If well processed, locally produced rice can compete favourably with imported ones and add market value to the product with its intact nutrients. After harvest, rice paddy needs to be processed before a consumable commodity can be obtained. Parboiling and milling are two essential activities that take place during processing. The purpose of the operation is to respond to consumer preferences while it also has a positive effect on the nutritional properties.

Video instructional package could be used to improve the knowledge of local rice farmers especially during rice processing with a view to improving the parboiling and milling qualities of their product. Consructivism, a learning theory based on the ideas of revered educational philosophers, psychologists and practitioners such as John Dewey, Jerome Bruner, and Lev Vygotsky among others, strongly calls for the use of video in instructional activities. Authors like Hackbarth (1996); Gagne and Medsher (1996); Heinich, Moluda, Rusell & Smaldino (2002) generally present the viewpoints of Constructivists in such a way that authentic activities should be part and parcel of

instructional presentation. According to them, emphasis should be placed on packaging learning activities on video which learners will interact and interpret according to their understanding.
In a study, Bourhis and Allen (2005) conducted an experimental study dealing with the use of videotaping to provide feedback to students in public speaking courses. The result of the investigation indicated that the use of videotaping to provide feedback to students in public speaking courses results in better content of students' speeches, greater acquisition of public speaking skills, better performance in objective test and more positive attitude towards the course in public speaking.

Also, Zossou, Van, Vodouche and Wanvoeke (2009) compared farmer-to-farmer video training method with conventional workshops in training rural women of improved rice parboiling process in central Benin. The findings of the investigation revealed that about 95% of those who watched the video adopted the content of the video package in processing their rice.

Purpose of the Study

The main purpose of this study was to investigate the influence of video instructional package on productive rice processing in rice production communities of Kwara State, Nigeria. Specifically, the study examined;

(i) the parboiling qualities of rice processed after watching the video instructional package in rice processing.
(ii) the milling qualities of rice processed after watching the video instructional package in rice processing.
(iii) whether the rice processed after watching the video instructional package is cleaner with regards to impurities.

Methodology

The research design employed for this study was One-shot case study design. It was a pre-experimental procedure that involved one group of dependent variable. This single group was exposed to treatment and a time interval was allowed before post-testing.

The population for this study consisted all rice farmers in rice production communities of Kwara State. Adult rice farmers in Shonga, Patigi, Bacita, Lafiagi and Charagi communities were sampled for the study. In the selected communities, two hundred and fifty (250) adult rice farmers were sampled for the study using purposive sampling procedure. This was because only full-time adult rice farmers who have rice paddy to be processed as at the time of this investigation were involved.

A researcher adopted treatment was used. It was packaged from real life experience by Africa Rice Centre, Republic of Benin and named Video Package Instruction in Rice Processing (VPIRP). The content covered rice processing activities like rice drying, parboiling and milling. Oral interview was the test instrument employed and it comprises a set of structured questions on rice processing. It was conducted in Yoruba, Hausa or English language.

Fifty full-time adult rice farmers in each of the five selected communities were exposed to the instructional package using video player, multimedia projector and screen or television set. After a time interval of four weeks, they were interviewed using a set of structured question items on rice processing. The responses of the 250 rice farmers in the interview were analyzed using simple percentage and report method. The analysis was done to provide answers to the research questions.

Results

Research Question 1: What is the influence of video instructional package in rice processing on the parboiling qualities of rice processed?

Table1: Rice processors' response on rice parboiling qualities

Community	Rice Processor	Rice Processor with Improved Parboiling Responses	Percentage (%)
Bacita	50	34	68.00
Charagi	50	37	74.00
Lafiagi	50	38	76.00
Patigi	50	34	68.00
Shonga	50	30	60.00
Total	250	173	69.20

Figure1: Areas improved by parboiling in rice processing

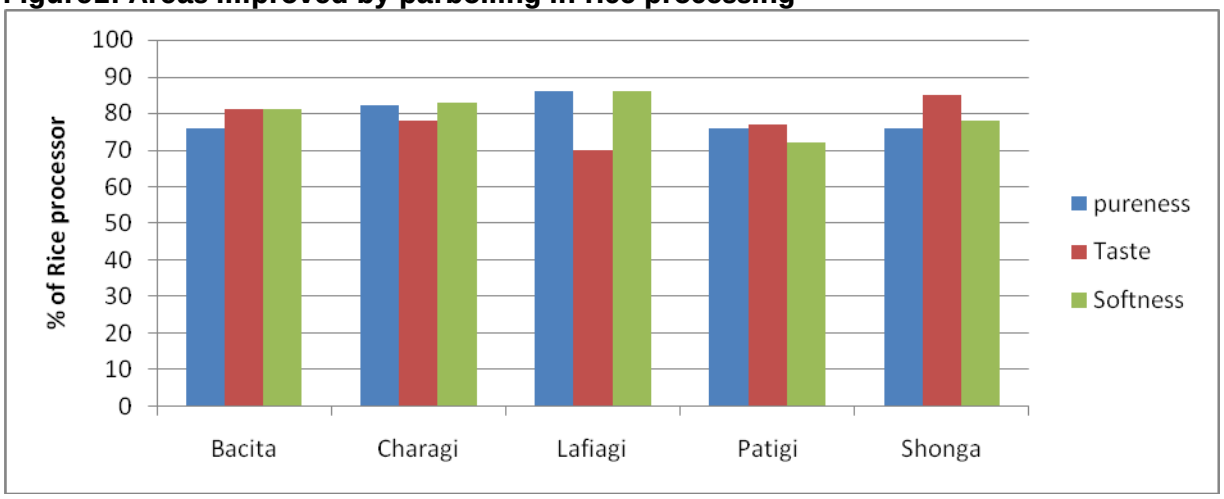


Table 1 revealed that 173 out of 250 rice processors representing 69.20% responded that the video instructional package in rice processing improved the parboiling qualities of rice processed after watching the package. Figure 1 revealed that over 70% of the respondents in each community surveyed, responded that the rice parboiled after adopting the content of the video package was pure, soft and tastes better when cooked.

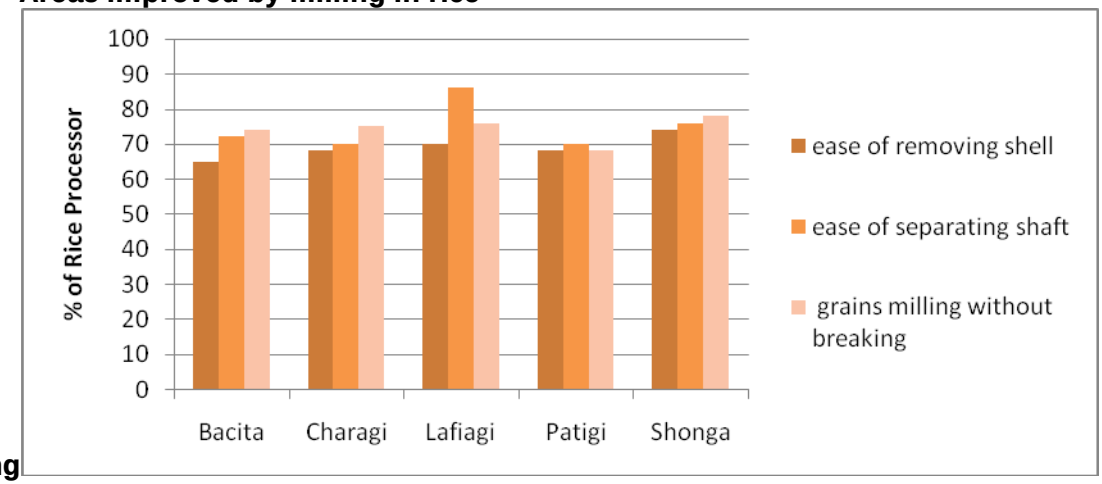
Research Question 2: What is the influence of video instructional package in rice processing on the milling qualities of rice processed?

Table2: Rice processors' response on milling qualities in rice processing

Community	Rice Processor	Rice Processor with Improved Milling Responses	Percentage (%)

Bacita	50	37	74.00
Charagi	50	42	84.00
Lafiagi	50	38	76.00
Patigi	50	39	78.00
Shonga	50	20	40.00
Total	250	176	70.40

Figure 2: Areas improved by milling in rice processing



Analysis of the responses of rice processors surveyed as shown in Table 2 revealed that 176 out of 250 respondents representing 70.40% had the milling qualities of their rice processed after watching the video instructional package improved. Also, Figure 2 revealed that over 70% of the processors who responded that the milling qualities of their rice processed after watching the video package were improved. Also, over 70% of each of the samples surveyed responded that it was easy for them to remove shell, separate shaft during milling and were also able to mill their grains without breaking.

Research Question 3: Is the rice processed after watching the video instructional package in rice processing cleaner with regards to impurities?

Table 3: Rice processors' response on cleanliness of rice processed from impurities

Community	Rice Processor	Rice Processor with freedom from impurities responses	Percentage (%)
Bacita	50	38	76.00
Charagi	50	34	68.00
Lafiagi	50	34	68.00
Patigi	50	38	76.00
Shonga	50	30	60.00
Total	**250**	**174**	**69.60**

Figure 3: Specific impurities cleaned in the rice processed

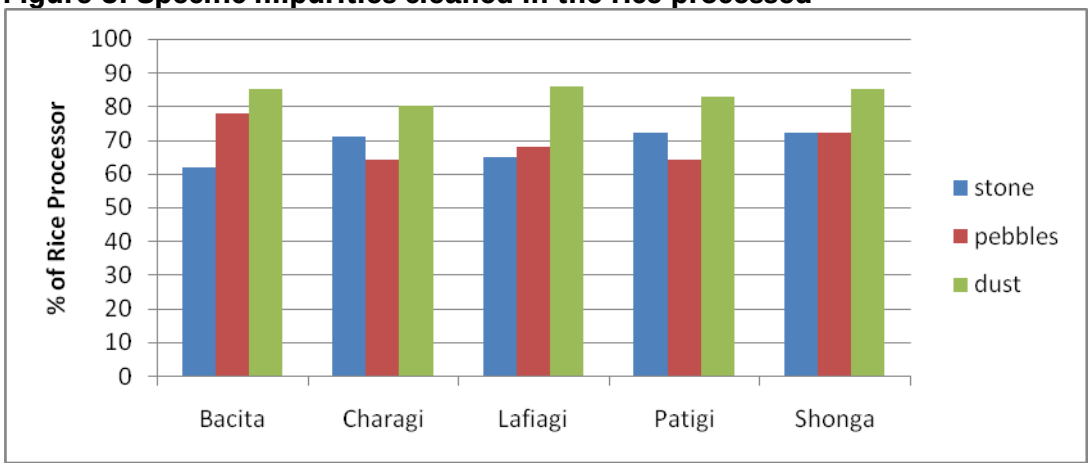


Table 3 revealed that 174 out of 250 respondents representing 69.60% responded that the rice processed after watching the video instructional package in rice processing was cleaner and free from impurities. Figure 3 revealed that over 70% of the rice processors who responded that their rice processed after watching the video package was cleaner (with regards to impurities) also responded that the rice processed was free from dust, pebbles and stones.

Discussion of Findings

The findings of this study revealed that video instructional package on rice processing improved the parboiling and milling qualities of rice processed by 69.20% and 70.40% of rice processors after watching the package respectively. This is in agreement with Fakomogbon (1997) that video instructional package is capable of improving learners' performance in activities contained in the package and also in agreement with Zossou, et al (2009) that video training method has the tendency of improving rice parboiling and milling practices.

Conclusions

From the analysis and findings of this study, it is logical to conclude that video instructional package is a powerful tool that can be employed to improve the quality of rice being processed by local processors. The response of majority of the rice processors sampled for the study indicated that the content of the package improved the parboiling, milling and cleanliness qualities of the rice processed. There is no doubt that the rice processed after adopting the content of the video instructional package is of high quality and can compete with imported commodity in the market.

Recommendations

Based on the findings of this study, the following recommendations are made:

(i) Government and other relevant bodies should employ video instruction as a means of informing, and training rice farmers on rice processing with a view to improving their production.

(ii) Rice farmers should always adopt the content of video instructional package on rice processing while carrying out their parboiling and milling practices

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EFFECTS OF GENDER AND AGE ON THE MATHEMATICS ACHIEVEMENT OF SECONDARY SCHOOL STUDENTS IN MINNA METROPOLIS, NIGER STATE

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Abstract
This study investigated the influence of gender and age on the mathematics achievement of secondary school students in Minna metropolis, Niger State. An ex-post-facto research design was adopted for the study. A total of 195 students in the intact-classes selected by simple random sampling from five purposively selected schools were used. The instrument used was a 50-item mathematics achievement test (MAT) developed by the researcher which was validated by four experts in the field of mathematics. The reliability coefficient of the instrument was 0.87. Two research questions were formulated and tested for the study. Means, standard deviations and Z-test statistic were used to analyze the data obtained. The findings show that (i) the performance of the male students was better than the performance of the female students (ii) there was no significant difference in the performance of younger and older male students in Minna metropolis. One of the major recommendations was that the girls should be properly encouraged by their parents and teachers from childhood in their respective schools to see mathematics as a simple subject. This can be done by acquitting the girls with objects that are mathematics inclined in order to arouse and sustain their interest in the subject at a tender age.

Introduction

There is indeed no doubt that in any society in the world, men and women, boys and girls, are assigned different roles as dictated by the culture of the people. This, therefore, shows that to a greater extent, the differences in the behaviours of males and females are mainly socially determined rather than biologically or genetically influenced. Archibong (2001) sees gender as rather, being socially oriented and, therefore, dynamic. Thus, this has led many researchers to examine gender differences right from the time measures of intellectual ability were first developed (Ong, 1981; Person and West, 1991; Callahan and Clements, 1984; Nwaneri, 1997; Bordo, 2001; UNESCO, 2003; Reid, 2003; Abiam and Odok, 2006).

Unfortunately, the school which is supposed to be an agent of socialization and reorientation, has not been able to do much in this respect but, rather, has widened the gap that exists in intellectual ability of males and females. According to Archibong (2001), even the school hierarchy and organization, norms and values reflect those aspects of the dominant culture which is masculine. The school which is supposed to be a mini- society imbibes the culture of the larger society and, therefore, relegates female child to the background.

In the same vein, Fafunwa (1990) opined that for too long, the woman has lived in the shadow of her male counterpart and this has over the centuries created a psychological complex in the minds of society which thinks the female gender is made to play a second fiddle. That gender differences seem not to surface until age ten (Callahan and Clements, 1984; Dossey, Mulis, Lindquist and Chambers, 1988) suggests that the decline of female achievement is the result of a strong pattern of socialization rather than to gender differences in innate ability.

Owing to the importance of mathematics, the Federal Ministry of Education, according to the National Policy on Education (FME, 1981) has made it to be one of the core subjects to be offered by every student from the primary to the pre-tertiary levels of education. Mathematics, as the saying goes, is the bedrock upon which scientific knowledge rests and, hence, for a modern existence, amidst the fast rate of technological advancement, a good knowledge of mathematics is inevitable. Since mathematics is a "sine qua non" for the technological development of any nation, researchers have been prompted to examine critically the issue of gender differences in performance of learners in mathematics. According to Callahan and Clements (1984) and Dossey, Mulis, Lindquist and Chambers (1988), girls' mathematics achievement in the elementary grades is equal to boys' but decreases in the middle school. Hanna (1989) found that, in some countries, girls were more successful than boys, while in others the opposite was true. She, therefore, opposed the theories that attempted to explain boys' superiority in mathematics on the basis of biological differences. In the opinion of Meyer and Koehler (1990), it appears reasonable to believe that lesser confidence or greater anxiety on the part of females is an important variable which helps to explain sex-related differences in the study of mathematics.

Since the researcher observed that the results of the studies on gender differences in mathematics are inconclusive and deficient in some important aspects such as cognitive development of the child, the researcher therefore, hoped to address this situation in the study. What then could be said to be responsible for the one-sided tendency of having more men as celebrated mathematicians than women? Could it be that the speculation that as male grow in age, there could be a low performance in mathematics is true? This speculations, if true could put the country's hope of scientific achievement in jeopardy. These situations prompted the researchers to investigate effects of gender and age on the mathematics achievement of secondary schools in Minna, Niger State.

To facilitate the investigation, two research questions were raised:
Is there any significant difference in the mathematics achievement of:
1. Male and female secondary school students in Minna metropolis?
2. Younger and older male secondary school students in Minna metropolis?

Methodology

Sample and Sampling Techniques

The population of the study was made up of twenty five senior secondary schools in Minna metropolis comprising twenty-two co-educational and three single-gender schools.
Five schools were purposively selected based on the types of senior secondary schools in the metropolis for the study; three co-educational and two single-gender schools. In each of the schools, an intact arm of the SS2 classes was selected using simple random sampling. A total number of hundred and ninety five (195) students were used. The table below shows the distribution of male and female students from the selected senior secondary schools.

S/N	Name of School	Type of School	No. of Male	No. of Female	Total
1	Federal Government College, Minna.	Federal Public Co-Educational School.	12	14	26
2	Himma International School, Minna.	Private Co-Educational School.	10	11	21
3	Day Secondary School, Tunga, Minna.	State Public Co-Educational School.	36	28	64

4	Maryam Babangida Girls' Science College, Minna.	State Public Single (Girls) School.	0	32	32
5	Government Secondary School, Minna.	State Public Single (Boys) School.	52	0	52
	Total		110	85	195

Research Instrument

The main research instrument used for the study was a researcher prepared 50 – item mathematics achievement test (MAT). The 50 – test items were multiple – choice items, each having a main stem and five options lettered A-E.

The areas covered in the mathematics achievement test were Algebra, Numbers and Numeration, and Trigonometry. In Algebra, the topics covered were algebraic simplifications, quadratic equations, quadratic graphs, factorization, substitution, and subject of the formula. In Numbers and Numeration, the topics treated were fractions, decimals, percentages and simple interest. In Trigonometry the topics treated were bearings and trigonometric ratios. Seventy (70) items were initially prepared and subjected to face and content validation by four experts; two senior lectures in the department of mathematics, Federal University of Technology, Minna and two chief education officers from two different secondary schools, also in Minna.. The result of the validation was used to select sixty questions, which were used for the pilot test in Hill-Top Secondary School, Minna. Thirty SS2 students were used for the pilot test. For items which were used for the study. The test items were built around four levels of Bloom's Taxonomy of educational objectives of learning as described in Table 2.

Table 2: Blue print reflecting levels of bloom's taxonomy and their corresponding items

S/N	Level of Cognitive Domain	Topic	Number of Items	Total
1	Knowledge	Algebra	9	
		Trigonometry,	6	
		Number and Numeration	3	18
2	Comprehension	Algebra	6	
		Trigonometry	2	
		Number and Numeration	5	13
3	Application	Algebra	7	
		Trigonometry	1	
		Number and Numeration	4	12
4	Evaluation	Algebra	4	
		Trigonometry	1	
		Number and Numeration	2	7
	Sum Total			50

The experts used criteria of ambiguity, clarity and simplicity to determine which items fitted for each level of cognitive domain used. The instrument was tested using Kuder Richardson (K-R 21) formula for reliability and the reliability coefficient yielded was 0.87, indicating a high reliability.

In each of the five purposively selected schools, arrangements were made with the Principals of the schools in collaboration with the Heads of Mathematics Department and the Mathematics teachers in the selected schools for permission and assistance to be allowed to make use of the students and their periods to administer the mathematics achievement test. MAT was administered to the students by the researchers, students answers were graded and the scores obtained were recorded and the data analysed.

Results

The data collected was analyzed using percentages, means, standard deviations and independent Z-test analysis. The significant level adopted for the statistical test was 0.05.

Research Question One

Is there any difference in the mathematics achievements of male and female secondary school students in Minna metropolis?

Table 3: Z-test comparison of mean scores of male and female students in mathematics achievement test

Variable	N	X	S.D	df	Z-Value Calculated	Z-Value Critical	P
Male	110	51.946	26.828	193	7.055*	1.66	0.001
Female	85	28.988	15.302				

*Significant at 0.05 levels

Table 3 shows the result of the Z-test comparison of the mean scores of male and female students in the mathematics achievement test. The result on the table indicates that there is significant difference in the mean scores of males (51.946) and the females (28.988) at 0.05 level of significance (Z_{cal} (7.050) > Z_{crit} (1.66), df=193, p<0.05). therefore, this means that there is statistical difference in the performance of male and female students in the mathematics achievement test.

Research Question Two

Is there any significant difference in the mathematics achievements of younger and older male secondary school students in Minna metropolis?

Table 4: Z-test comparison of mean scores of younger male and older male students in the mathematics achievement test

Variable	N	X	S.D	df	Z-Value Calculated	Z-Value Critical	P
Younger Male	38	55.895	26.508	108	1.23^{ns}	1.66	0.264
Older Male	72	49.861	26.945				

ns: Not Significant at 0.05 level

Table 4 shows the result of the Z-test comparison of the mean scores of younger and older male students in the mathematics achievement test. The result on the table indicates that there is no significant difference in the mean scores of younger males (55.895) and the older males (49.861) at 0.05 level of significance (Z_{cal}(1.23) < Z_{crit} (1.66), df=108, p<0.05). therefore, this means that there is no statistical significant difference in the performance of younger and older male students in the mathematics achievement test.

Discussion of Results

From the result of Table 3, it was found that boys performed better than the girls in the mathematics achievement test. The finding agreed with the study carried out by Faculty of Education, University of Benin (1987) on technological training in Nigeria, that the female performance is significantly lower than the performance of males in mathematical subjects at the secondary school level. The result is also supported by those studies of Michelmore (1973), Nwagwu (1977), Mills, Ablard (1993) and Leder (1992) that boys proved superior to girls in mathematics. This finding could be attributed to many factors such as strong relationship of socialization to mathematics success or failure rather than to gender differences in innate ability (Callahan and Clements, 1984); greater anxiety on the part of the female students (Meyer and Koehler, 1990), and self-defeatist attitude on the part of the females. From the point of view of the researchers, this means that the women who are engineers, doctors, etc were able to deliberately work against the enumerated factors in order to excel and be where they are today. Girls, therefore should aim at nothing else but outright success in their mathematical pursuits.

Also From the result of Table 4, it was observed that the performance of the younger male students in the MAT did not show any appreciable difference when compared with the older male students. This is to say that the level at which a male student performs in mathematics at a younger age might not likely change when he grows older. This finding is in agreement with that of Olagunju (1996) who found that there was no significant difference in the performance of boys whether they were young or old.

Conclusions

The findings of this study serve as the basis for making the following conclusions; that male students are better than female students in the branches of Mathematics (Algebra, Number and Numeration and Trigonometry) treated in the research in Minna metropolis, age is no barrier to the studying of mathematics within the age range of thirteen (13) and twenty two (22); and that gender has an effect on the performance of students in mathematics.

Recommendations

The following recommendations have been proffered based on the findings of the study:

1. Girls should be properly encouraged by their parents from childhood and teachers in their respective schools to see mathematics as a simple subject. They should also be acquainted with objects that are mathematically inclined for example, triangles, squares, circles, etc, so as to arouse the girls' interest in the subject at a tender age. This would make the girls to grow up with this interest and not depart from it.
2. Schools, in partnership with government, should reward female students who excel in mathematics with scholarship for example, the best female student in mathematics in a session. This would lead to a healthy competition among the female students.

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BASIC SAFETY PRACTICE SKILLS NEEDED BY ELECTRICAL/ELECTRONIC STUDENTS FOR EFFECTIVE OPERATION IN THE WORKSHOP

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Abstract

The study was carried out in Federal Capital Territory, Abuja and Niger State to identify basic safety practice skills that students of Electrical/electronic students required to enable them carry out effective operation in the workshop. To achieve this objective, 3 research questions were developed while 3 null hypotheses were formulated and tested a 55-item structured questionnaire was developed from the literature reviewed for the study and utilized in collecting data. Survey research design was adopted for the study. The sample for the study was 52 respondents made up of 27 Electrical/electronic Teachers and 25 College Administrators. The structured questionnaire was face validated by 3 experts knowledge in Electrical/electronic. The Cronbach alpha method was used to test reliability of the questionnaire items to obtain a coefficient of 0.87. The questionnaire was administered on 52 respondents. The weighted mean and standard deviation were used to answer the research questions while t-test statistic was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed that 52 basic safety practice skills were required by Electrical/electronic students for effective operation in Electrical/electronic workshop. There was no significance difference in the mean response of college Administrators and Electrical/electronic teachers on the basic safety practice skills required by Electrical/electronic students for effective operation in the workshop. It was therefore recommended that the basic safety practice skills identified by this study should be made available to teachers and students of Electrical/electronic trade in Technical Colleges to acquit them with necessary basic safety practice skills that are needed in the workshop

Introduction

Electrical/electronic Trade is one of the sub-professional trades offered at the technical colleges, it is one of the vocational education courses which are only form of education whose primary purpose is to prepare and provides individual student with the skills, knowledge and an attitude necessary for employment in specific occupations (Okoro, 1999). According to Olaitan (1996), vocational education is the essential preparation that will enable the individual to meet his/her developmental needs and aspirations which for many will constitute an immediate entry into the world of work. It also has been noted that the extent of technological development and growth of any country is dependent on the quality and effectiveness of her technical and vocational education. Brennam and Little cited in Okon (2012) asserts that, as long as vocational education is an integral part of sustainable self employment, frequency of training to reflect the relevant skills should be encouraged by vocational educators and other agencies that provide such training skills. The emphasis is to allocate more time to practical skill over theory in each trade during training as this will enable the trainees to gain practical experience in their chosen vocation so as to be gainfully employed in the world of work as technical personnel.

The programme for Electrical/electronic trade in Nigeria technical colleges is designed to produce competent craftsmen in various Electrical/electronic trade. According to National Board for Technical Education (NBTE 2001), a graduate of Electrical/electronic is expected to operate equipment, machines and perform other Electrical/electronic skills like fault diagnose and repair of Radio,

Television, Communication system and equipment for production purposes in private practices or in the industries. These graduates may proceed to tertiary institutions for further studies in Technical Education. A National curriculum is adopted in all the technical colleges accredited by NBTE. The programmes in technical colleges are offered at levels leading to the award of National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC) for craftsmen and master craftsmen respectively (Federal Government of Nigeria, 2000). The Federal Government of Nigeria (FRN, 2004) pointed out that the main feature of the curricular activities for technical colleges shall be structured in foundation and trade modules, the curriculum for each trade shall consists of general education, theory and related courses, workshop practice industrial training components and small business management and entrepreneurial training. The trade theory and workshop practice involve the study of basic electricity, Battery Charging, Domestic Installation, Industrial Installation, Cable Jointing and Winding of Electrical Machines electronics device and circuit, radio communication, radio and audio frequency amplifier, satellite transmission and reception and television This curriculum if adequately implemented is expected to produce competent craftsmen in Electrical/electronic trade for industrial and technological development in Nigeria. Such Craftsmen can be employable or be self-reliant if he possesses adequate skills and is competent.

However, the increase in accident rate in the Electrical/electronic workshop during the various operations call for more advanced instruction on accidents prevention that requires increase emphasis on safety. Krause, John & Sternly (1990) stated that their discussion with laboratory and factory workers revealed that emphasis should be placed on safety education because of sophisticated machines and equipment which are becoming increasingly complicated and digitalized. They further stated that the need for industrial safety became necessary because of millions of industrial accidents occurring yearly which results in injuries, permanent or temporary disablement and sometimes in dead.

Mannuela (1993) defined safety as the art and science of identifying, evaluating and controlling work place hazards; they further emphasized that safety is the state of being certain that adverse effect will not be caused by some agents under defined condition. Safety according to the opinion of Olaitan, Nwachukwu, Igbo, Onyemechi and Ekong (1999) is an art of inculcating the necessity of taking precautions for the avoidance of personal injuries or reducing accidents in order to protect people and property. Lutze (1978) stated that real safety means safeguarding against damage to machines tools and materials as well as preventing personal injuries. These experts agreed that every step toward skills acquisitions must first address the subject matter of industrial accident and safety.

Krejice (1992) provided vocational educational theory which supports that effective skills acquisition in vocational education can only be secured when the teacher has successful experience in the application of skills and knowledge of safety practice to the operations and processes he undertakes to teach. In the context of this study, safety is any method, technique or process which can minimize or prevent accident in industries and workshops of technical colleges.

According to the National Safety Council (1998) accident is occurrence in an industry or establishment causing bodily injuries to a person which make him unfit to resume his duties in the next 48 hours. It further poised that accident is an unwanted, unexpected event which cannot be anticipated in advance. Occurrence of accidents in the workshop are always increased by improper dressing, ignorance, over confidence, carelessness, non-provision of required safety guards to revolving parts of machines filthiness, insensitivity, distraction, influence of alcoholic and abuse of tools. These call for Electrical/electronic students at the technical college who are being trained for employment in an occupation that required laboratory activities to be conversant with safety practice

skills right from the school. This will reduce the high rate of accidents in workshop as well as industries.

Safety practices according to the School Board Safety Policies (1998) are those activities that seek either to minimize or to eliminate hazardous conditions that can cause bodily injuries. Safety practice in the context of this study is the effort directed at preventing or eliminating accidents in the workshop by the teachers, students and school administrators. Safety practices is a team activities which requires that everyone in the workshop should think and act responsibly at all times and in every activities. The electrical/electronic teacher who is a link between the students and the materials being taught should have the skills of manipulating tools and machines safely without fear of being involved in accident.

Skills in the opinion of Osinem and Nwoji (2005), is the ability to be able to perform activity expertly. They further explained that skill is a well established habit of doing things and involves acquisition of performance capabilities through repetitive of an operation. Ede (2001) also defined skill as expertness or dexterity or practice ability of facilitating or doing something. In the context of this study skill is the demonstration of dexterity or the ability of manipulating step by step processes of Electrical/electronic operations such as charging, soldering, laying of cables, cable jointing, domestic and industrial installation and measuring in the technical college electrical/electronic workshop or laboratories with little or no wastage of necessary resources.

Olaitan (1996) observed that technical college graduates do not possess adequate skills necessary for self-employment or employment in industries and for effective operation in workshop or laboratories. And coupled with the facts that there is wider scale of accidents that takes place in technical colleges' laboratories due to carelessness or lack of safety practices skills by students and teachers. This study was therefore designed to identify those safety practice skills that electrical/electronic students need for effective and efficient operation in the workshop.

Statement of the problem

In Electrical/electronic workshop, both in technical colleges and industries, teachers and students are prone to accidents as a result of the nature of operations involved. For any operation to be carried out effectively, teachers and students must possess basic safety practices skill in order to prevent or totally eliminate occurrences of accidents which may result in human and material resources wastage.

Accidents may also occur in the workshop due to non-observance of simple workshop rules and regulations. Students are often exposed to hazard without the necessary safety instructions to guide them during practical exercises. Teachers often fail to inculcate safety practices skills into the students due to the fact that instructional resources such as posters, bulletin boards and films are not provided by the authority concerned. Where they are available the teachers may lack the knowledge and skills to apply and administer the safety tools and equipment.

In workshop or laboratory some activities or operations sometimes inflict serious injuries to students such as deep cut, fire burnt, electric shock and even serious explosion and these has caused serious damage to the workshop building, equipment and amputation of the student hand. The development of students for industry to use equipment, electricity and other hazardous material requires early safety practice education and good safety training can eliminate or reduced most of the carelessness and protect teacher, students and industrial workers from work related accidents. Hence the study is designed to identify the safety practice skills required by Electrical/electronic students of technical colleges for effective operation in the workshop.

Purpose of the Study

The major purpose of this study is to identify the safety practice skills required by Electrical/electronic students of technical colleges for effective operation in the Electrical/electronic workshop.

Specifically, the study will identify:

(i) General safety practice skills required by Electrical/electronic students for effective operation in the Electrical/electronic workshop

(ii) Safety practice skills required by Electrical/electronic students for effective operation in Electrical workshop

(iii) Safety practice skills required by Electrical/electronic students for effective operation in Electronics workshop

Research Questions

The following are the research questions for this study;

(i) What are the General safety practice skills required by Electrical/electronic students for effective operation in workshop?

(ii) What are the safety practice skills required by Electrical/electronic students for effective operation in Electrical workshop?

(iii) What are the safety practice skills required by Electrical/electronic students for effective operation in Electronics workshop?

Hypotheses

The following null hypotheses which were tested at 0.05 level of significance guided this study:

HO_1: There is no significant difference between the mean rating of the responses of Electrical /electronic teachers and College Administrators on the General safety practice skills required by Electrical/electronic students for effective operation in workshop

HO_2: There is no significant difference between the mean rating of the responses of Electrical/electronic teachers and College Administrators on the safety practice skills required by Electrical/electronic students for effective operation in Electrical workshop

HO_3: There is no significant difference between the mean rating of the responses of Electrical/electronic teachers and College Administrators on the safety practice skills required by Electrical/electronic students for effective operation in Electronics workshop

Methodology

Three research questions were developed and answered by the study while 3 null hypotheses were formulated and tested at 0.05 level of significance. Survey research design was adopted for the study. A 55 items structured questionnaire was developed from the literature review for the study and utilized in collecting data. The scale for the questionnaire were Highly Required (HR), Required(R), Moderately Required (MR) and not Required (NR) with values 4, 3 2 and 1 respectively.

The population for the study was 52 made up of 25 college administrators (Principals, Vice Principals and HODs) and 27 Electrical/electronic teachers. The entire population was used for the study due to their manageable size. The questionnaire items were validated by three experts in Electrical/electronic who are knowledgeable in workshop safety practices. Cronbach alpha technique was used to determine the reliability of the instrument (questionnaire) and co-efficient of 0.87 was obtained. The questionnaire was administered on 52 respondents. All the 52 copies were retrieved and used for analysis.

The weighted mean and standard deviation were used to answer the research questions while t-test statistics was used to test the hypotheses at 0.05 level of significance. The arithmetic mean of the scale of the items is 2.50. Any item with a weighted mean at 2.50 and above was regarded as

important basic safety practice skill required for effective operation in Electrical/electronic workshop, while any item with a weighted mean value below 2.50 was not regarded as an important basic safety practice skill for effective operation in Electrical/electronic workshop.

The standard deviation was used to determine the closeness or otherwise of the responses of the respondents from the mean. Any item with a standard deviation at 1.96 and below show that the respondents were close to the mean, indicating that the mean values of the items were valid. Any item with a standard deviation above 1.96 indicated that the respondents were not close to the mean and therefore the mean values of the items were less valid. The null hypothesis was accepted for any item whose t-calculated value was less than the t-table value and rejected if on the contrary.

Results

Research questions 1

What are the general basic safety practice skills required by electrical/electronic students for effective operation in the workshop?

Table 1: Mean ratings of the responses of college administrators and electrical /electronic teachers on the general basic safety practice required by electrical/electronic students for effective operation in the electrical /electronic workshop

S/N	Items statement	$\bar{X}$	SD	Remarks
	Ability to			
1	Turn off and unplug equipment (instead of relying on interlocks that can fail) before removing the protective cover to clear a jam, replace a part, adjust or troubleshoot.	2.74	0.83	Required
2	Not use an electrical outlet or switch if the protective cover is ajar, cracked or missing.	3.33	0.50	Required
3	Use dry hands and tools and stand on a dry surface when using electrical equipment, plugging in an electric cord, etc.	3.49	0.51	Required
4	Never put conductive metal objects into energized equipment.	3.40	0.46	Required
5	Always pick up and carry portable equipment by the handle and/or base. Instead of carrying equipment by the cord.	3.48	0.96	Required
6	Unplug cords from electrical outlets by pulling on the plug instead of pulling on the cord.	3.11	0.88	Required
7	Use extension cords temporarily and the cord should be appropriately rated for the job.	2.96	0.93	Required
8	Use extension cords with 3 prong plugs to ensure that equipment is grounded.	2.56	0.83	Required
9	Never remove the grounding post from a 3 prong plug so that you can plug it into a 2 prong, wall outlet or extension cord.	2.54	0.72	Required
10	Re-route electrical cords or extension cords so they aren't run across the floor, under rugs or through doorways, etc.	2.45	0.89	Required
11	Not to overload extension cords, multi-outlet strips and wall outlets.	2.66	0.89	Required

12	Heed the warning signs, barricades and/or guards that are posted when equipment or wiring is being repaired or installed or if electrical components are exposed.	3.13	0.66	Required
13	Equip Instructional Laboratories with Ground Fault Current Interrupt (GFCI) circuit breakers and check for leakage paths to ground when breakers trip repeatedly and the problem are not due to an overload.	3.35	0.54	Required
14	Equip any equipment used in the laboratories with a standard three-prong AC plug or a two-pronged polarized plug.	2.96	0.83	Required

Key: × = Mean; SD = Standard Deviation

The data presented in table 1 shows that 13 out of 14 in table 1 had their mean values ranged from 2.54 – 3.48. This implies that the means were above the cutoff point of 2.50 indicating that the respondents agreed to the 13 items as general basic safety practice skills required in Electrical/electronic workshop. However, item 10 had mean value of 2.45 which is below 2.50. This showed that the respondents disagreed that the item was an important basic safety practice skill required for effective operation Electrical/electronic workshop.

The table also revealed that the standard deviation (SD) of the item ranged from 0.50-0.93 which was below 2.00. This indicated that the respondents were not far from the mean and from one another in their responses. This indicated that the items were valid.

Research Question 2
What are the basic safety practice skills required by electrical/electronic students for effective operation in Electrical workshop.

Hypothesis 2
There is no significant difference in the mean ratings of the response of college administration and Electrical/electronic Teachers on the basic safety practice skills required by electrical/electronic students for effective operation in Electrical workshop.

Table 2: **Mean ratings and t-test analysis of college administrators and Electrical /electronic teachers on the basic safety practice skills required electrical /electronic students for effective operation in electrical workshop**

S/N	Item Statement	×	SD	Remarks
	Ability to:			

1	Understand that all exposed non-carrying metal parts of fixed and portable equipment that may accidentally become energized should be grounded.	2.65	0.23	Required
2	Understand that all electrical equipment or apparatus that may require frequent maintenance must be capable of being completely disconnected from the power source.	2.70	0.23	Required
3	Never work alone on energized or equipment over 50 volts peak Know that making contact with the conductor(s) of a supposedly dead power system should be done with the back of one hand, so that if a shock should occur, the muscle reaction will pull the fingers away from the conductor.	3.01	0.35	Required
4	Always verify that a circuit has been secured in a Zero Energy State with test equipment after locking it out.	2.52	0.88	Required
5	Place personal padlock or combination lock on that will serve as lock out/tag out on every energy disconnect device relevant to the task on the system.	2.58	0.33	Required
6	Temporary connect grounding or shorting wires to a load being serviced for extra protection to personnel working on that load.	3.32	0.38	Required
7	Disconnect switch devices in a properly designed electrical system to allow for convenient readiness of a Zero Energy State.	3.20	0.78	Required
8	Never hurry, work deliberately and carefully.	2.99	0.81	Required
9	Always connect to the power last.	3.01	0.77	Required
10	Turn the main power switch off before you begin work on the circuits and wait a few seconds for power supply capacitors to discharge in order to prevent damage to circuits.	3.48	0.63	Required
11	Turn the power switch of the external supply off before you begin work on the circuits if connected to external power supply.	3.24	0.71	Required
12	Check circuit power supply voltages for proper value and for type (DC, AC, frequency) before energizing the circuit.	3.34	0.51	Required
13	Know that wires are not run over moving or rotating equipment, or on the floor, or string them across walkways from bench – to – bench.	3.31	0.31	Required
14	Know that conductive watch bands or chains, finger rings, wrist watches, etc. must be removed, and do not use metallic pencils, metal edge rulers, etc. when working with exposed circuits.	2.86	0.61	Required
15	Know that when breaking an inductive circuit open the switch with your left hand and turn your face away to avoid danger from any arc switch may occur across the switch terminals.	2.91	0.58	Required
16	Know that when using large electrolytic capacitors be sure to wait long enough (approximately five time constants)	3.35	0.65	Required
17	for the capacitors to discharge before working on the circuit.	3.13	0.75	Required
18	Understand that all conducting surfaces intended to be at ground potential should be connected together.	2.79	0.36	Required

Key: X = Mean; SD= Standard Deviation

The data presented in table 2 revealed that all the items had their mean values ranged from 2.52 – 3.34. This show that the means were above the cut-off point of 2.50 point indicating that the respondents agreed to the items as basic safety practice skills required for effective operation in electrical workshop. The table also revealed that the standard deviation (SD) of the items ranged from 0.23 – 081 which was below 2.00. This indicated that the respondents were not too far from the mean and from one another in their responses. This indicated that the mean values of the items were valid.

Research Question 3
What are the basic safety practice skills required by Electrical/electronic students for effective operation in Electronics workshop.

Table 3: Mean ratings of response of college administrators and electrical/ electronic teachers on the basic safety practice skills required for effective operation electronics workshop

S/N	Item Statement	$\bar{X}$	SD	Remarks
	Ability to:			
1	Always wear your safety glasses	3.29	0.61	Required
2	Keep soldering irons in their protective stand when not in use	3.48	0.25	Required
3	Always read the msds (material safety and data sheet) for all chemicals prior	3.31	0.56	Required
4	Always observe polarity when connecting components into a circuit, especially with electrolytic capacitors to their use	3.39	0.88	Required
5	Apply heat from a soldering pencil for not more than a couple of seconds to avoid heat damage.	3.14	0.57	Required
6	Keep the intensity on oscilloscope as low as possible when in use and all the down when not in use to avoid burning out the screen	2.94	0.61	Required
7	Make sure test instruments are set for proper function and range prior to taking a measurement	2.41	0.74	N/required
8	Measure uncertain qualities, start with the range switch on the highest setting	2.84	0.61	Required
9	Always replace shields that were removed during service to avoid signal radiation	3.29	0.41	Required
10	Cut with an x-acto knife, avoid cutting towards yourself.	3.20	1.01	Required
11	Always cut wire leads so that the clipped wire falls on the table top and not toward others.	3.19	0.56	Required
12	Know that we do not touch the tip end of a soldering iron to check for heat	2.99	0.60	Required
13	Avoid skin contact with chemicals	3.39	0.44	Required
14	Replace of all screws, not just some.	3.09	0.49	Required
15	Use correct cleaning solvents for the job.	3.29	0.61	Required
16	Avoid pinching wires when putting equipment back together	3.39	0.45	Required
17	Use heat when soldering temperature-sensitive	3.00	0.45	Required

	components.			
18	Know that a circuit that has the power applied is never solders.	3.40	0.44	Required
19	Double check circuits for proper connections and polarity prior to applying the power	3.03	0.24	Required
20	Observe polarities when connecting polarized components or test equipment into circuit.	3.19	0.77	Required
21	Avoid excess heat to one area of the component when soldering a multi-pin component, and do not go from pin to pin in a straight line.	2.62	0.81	Required
22	Avoid an earth ground when working with ac powered units. Only work with powered units when necessary for troubleshooting.	2.85	0.66	Required

Key: X = Mean; SD= Standard Deviation

The data presented in table 3 revealed that 21 out of the 22 items had their mean values ranged from 2.52 – 3.40. This showed that their mean values were above the cutoff point of 2.50, indicating that the respondents agreed to the items as basic safety practice skills required for effective operation in electronics workshop. However, item 7 had a mean value of 2.41 which is below 2.50. This showed that the respondents disregard that the item was not an important basic safety practice skills required for an effective operation in Electronics workshop. The table also revealed that the standard deviation (SD) of the items ranged from 0.25 – 0.88, which was below 1.96. This implied that the respondents were not far from the mean and from one another in their responses. This also indicated that the mean values of the items were valid.

Hypothesis 1

There is no significant difference in the mean ratings of the responses of electrical/electronic teachers and college administrators on the general basic safety practice skills required by the electrical/electronic students for effective operation in the electrical/electronic workshop.

Table 4: t-test analysis of the responses of college administrators and electrical/ electronic teachers on the basic safety practice required by electrical/ electronic students for effective operation in the electrical/electronic workshop

Group	N	$\bar{X}$	SD	df	t-cal	t-crit	P < 0.05
Teachers	27	3.01	0.75	50	0.569	2.00	Not significant
Administrators	25	2.89	0.71				

Key

$\bar{X}$ = Mean

SD = Stand Deviation

N = Number of respondent

df = Degree of freedom

The data presented in table 4 revealed that t-calculated value is 0.569 as against t-critical value which is 2.00. Therefore, the null hypothesis of no significant difference is upheld. There is no significant difference between the mean the responses of college administrators and electrical/electronic teachers on the basic safety practice required by electrical/electronic students for effective operation in the electrical/electronic workshop.

Hypothesis 2

There is no significant difference in the mean ratings of the response of college administration and Electrical/electronic Teachers on the basic safety practice skills required by electrical/electronic students for effective operation in Electrical workshop.

Table 5: **t-test analysis of college administrators and Electrical/ electronic teachers onthe basic safety practice skills required electrical/electronic students for effective operation in electrical workshop**

Group	N	$\bar{X}$	SD	df	t-cal	t-crit	P < 0.05
Teachers	27	2.77	0.74	50	0.146	2.00	Not significant
Administrators	25	2.69	0.70				

Key

$\bar{X}$ = Mean

SD = Stand Deviation

N = Number of respondent

df = Degree of freedom

Table 5 showed that t-calculated value is 0.146 as against t-critical value which is 2.00. Therefore, the null hypothesis of no significant difference is upheld. There is no significant difference between the mean the responses of college administrators and electrical/electronic teachers on the basic safety practice required by electrical/electronic students for effective operation in the electrical workshop.

Hypothesis 3

There is significant difference in the mean ratings of the response of college administrators and Electrical/electronic Teachers on the basic safety practice skills required for effective operation Electronics workshop.

Table 6: t-test analysis of response of college administrators and Electrical/ electronic teachers on the basic safety practice skills required for effective operation electronics workshop

Group	N	$\bar{X}$	SD	df	t-cal	t-crit	P < 0.05
Teachers	27	2.89	0.51	50	0.388	2,00	Not significant
Administrators	25	2.97	0.59				

Key

$\bar{X}$ = Mean

SD = Stand Deviation

N = Number of respondent

df = Degree of freedom

The data presented in table 6 revealed that t-calculated value is 0.388 as against t-critical value which is 2.00. Therefore, the null hypothesis of no significant difference is upheld. There is no significant difference between the mean the responses of college administrators and electrical/electronic teachers on the basic safety practice required by electrical/electronic students for effective operation in the electronics workshop

Discussion

The study found out that 13 general basic safety practice skills were required for effective operation in Electrical/electronic workshop. While the findings on research question 2 revealed that 22 items are required for effective operation in Electrical workshop. The findings on research question 3 revealed that all the items except one are required for effective operation in Electronics workshop. These findings were in agreement with the opinion of Anant and Jeffrey (2007) who advised that all electrical students should consider safety an important aspect of their training activities. In the same vein, Krause, John & Sternly (1990) asserted that their discussion with laboratory and factory workers revealed that emphasis should be placed on safety education because of sophisticated machines and equipment which are becoming increasingly complicated and digitalized. Anant and Jeffrey (2007) also identified wearing of safety glasses, keeping soldering irons in their protective stand when not in use, turn off and unplug equipment before removing the protective cover to clear a jam, replace a part, adjust or troubleshoot and among others as safety practice skills required for effective operation in electrical/electronic workshop. In the same vein Olateju (2012) pointed out that safety education, proper usage of tools and equipment, wearing protective devices and good maintenance of equipment and machines are necessary safety practices that prevents accident in the workshop. Essenberge (1998) also agreed that many accidents occur in the workshop because safety equipment are lacking or because the workshop and its machineries are poorly designed. On hypotheses, the study found out that there was no significant difference in the mean ratings of the responses of the college administrators and electrical/electronic teachers on the basic safety practice skills required by electrical/electronic students for effective in electrical/electronic workshop. The implication of the findings is that the technical teachers and administrators of the respondents did not significantly differ in their responses on the identified items.

Conclusions and Recommendations

Electrical/electronic students of technical colleges required relevant safety practice skills for effective operation in the workshop and industry. These students need the skills for self employment or job creation in Electrical/electronic industry. The students should be made to be safety conscious and pay adequate attention to safety rules and regulations in the workshop. The Electrical/electronic teachers should therefore ensure that the skills are imparted to the students while they are still on training at the various technical colleges. The basic safety practice skills indentified by this study should be made available to teachers and students of Electrical/electronic trade in Technical Colleges to acquitant them with necessary basic safety skills that are needed in the workshop and government through her curriculum planner and developers should ensure that relevant safety practice skills are included in technical colleges' curriculum.

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CORRELATION ANALYSIS OF TEACHERS' CHARACTERISTICS AND INSTRUCTIONAL PRACTICES FOR QUALITY TEACHING AND LEARNING OF PHYSICS IN LAGOS STATE SECONDARY SCHOOLS

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Abstract
Physics teachers' characteristics and practices have been found to impact on students' achievement. This study employed descriptive survey design to see how teachers' characteristics and practices serve as correlates to the effective teaching and learning of physics. One hundred physics teachers were randomly selected from fifty Lagos state senior secondary schools. A teacher questionnaire was used to collect data which were analyzed using non-parametric statistics. Findings revealed that most teachers' characteristics and practices variables considered had positive relationship and impact on the teaching and learning of physics. Recommendations which include (i) motivating teachers to acquire higher education degree were suggested for improvement (ii) organizing teacher training programmes for teachers to improve their teaching skills, were suggested for improvement

Keywords: pedagogy, instruction, achievement, teacher characteristics, instructional practice, best practice

Introduction

Excellence in teaching and learning of physics depend on many factors among which are: the teacher, course content, availability of laboratory equipment, a clear philosophy and workable plan for meeting students' needs, serious dedication to learning goals, and adequate motivation (Nelson, 2006). The role of the teacher, however, is the most important. Without a well-educated, strongly motivated, skilled, well-supported teacher, the arch of excellence in high school physics will collapse. The teacher is the keystone of quality (Fred, Young & Batman, 2010).

Education research has continued to show that an effective teacher is the single most important factor of student learning (Darling-Hammond, 2000; Marzano, 2007). The physics teacher's knowledge base consists of three components which are content knowledge, pedagogical knowledge, and pedagogical content knowledge (Etkina, 2005). Content Knowledge is knowledge of the discipline itself, and includes such things as procedural methods. Pedagogical knowledge represents a "generic why and how to" of teaching. Pedagogical content knowledge (PCK) represents a situation-specific overlap of content knowledge and pedagogical knowledge. It can be described as "knowledge in context" and, Shulman (1986) pointed out that PCK includes knowledge of students' difficulties and prior conceptions in the domain, knowledge of domain representations and instructional strategies, and domain-specific assessment methods.

A number of studies (Car, 2006; Betts, Zau & Rice, 2003; Darling-Hammond, Holtzman, Gatin & Vasquez, 2005) have examined the effects of teacher characteristics, such as teachers' experience, preparation, and degrees earned on students' achievement. These studies concluded that teacher education, certification and experience are not strong predictors of teacher's effectiveness, as measured by student achievement gains. (Aaronson, Barrow & Sander, 2007) found that 90 percent of the variance in teacher's influence on student learning was not explained by teacher

characteristics such as highest level of education, experience, credentials, and selectivity of the school that the teacher attended.
The preponderance of evidence suggests that teachers who have completed degrees are not significantly more effective at increasing student learning than those with no more than a bachelor's degree. Rice (2003) examined students' achievement in a wide variety of grades and subjects areas; found that teachers having completed an advanced degree had no significant effect on students' performance. Ehrenberg & Brewer (1994) found a significant relationship between teacher completion of a master's degree and student achievement

The relevance of experienced physics teachers in the teaching and learning processes cannot be over emphasized. Tahir (2003) noted poor teaching process exhibited by inexperienced teachers as among the many problems of educational development in Nigeria. Best practices are an inherent part of a curriculum that exemplifies the connection and relevance identified in educational research. They interject rigour into the curriculum by developing thinking and problem-solving skills through integration and active learning. Relationships are built through opportunities for communication and teamwork. Four best practices for teachers include teaching a balanced curriculum, teaching an integrated curriculum, differentiating instruction to meet individual student needs and providing active learning opportunities for students to internalize learning (Public Schools of North Carolina, 2003).

Teacher clarity and organization which is part of science best practices has been found to correlate with student motivation, achievement, self-reported gains in knowledge, and problem solving. Goodman and Thomas (2010) suggested that the teaching professional and the field of physics are in a constant state of change. Teaching strategies are emergent and not absolute therefore quality professional development is critical to the retention and improvement of any teacher in the classroom.

Purpose of the study
This study was designed to investigate the teacher characteristics and instructional practices. In addition it was to find if there is correlation between physics teachers' characteristics and instructional practices variables in science teaching.

Statement of the problem
The issue of poor academic performance of students, Physics students inclusive in Nigeria has been of much concern to all and sundry. Nneji(19980 reported that the performances of students in West African Senior School Certificate Examinations(WASSCE) in sciences between 1988-1992 had been poor and that on average only 8.27% had credit while 31.2% had passes. Omiwale (2011) also reported that from 2002-2006, though the performances had improved, yet not as expected. According to him, the percentage pass at credit level were 47.66, 47.56, 51.02, 41.50 and 58.66 respectively. He went further to state that a special report of the Science Teachers Association of Nigeria (STAN) physics workshop held in Osogbo in 2004 fingered among other factors responsible for poor performances teachers' characteristics and instructional practices. Since over the years, students' academic performance in both internal and external examinations had been used to determine excellence in teachers and teaching (Ajao, 2001). This problem necessitated this research which is meant to find out the relationship between physics teacher's characteristics variables and best practices variables and its impact on the teaching and learning of physics.

Research questions
Six research questions were used in the conduct of the research. These are:

(i) Is there any relationship between teachers' qualification and instructional practices in the teaching of physics?

(ii) Is there any relationship between teachers' experience and instructional practices in the teaching of physics?
(iii) Is there any relationship between school type and instructional practices in the teaching of physics?
(iv) Is there any relationship between teachers' workshop attendance and instructional practices in the teaching of physics?
(v) Is there any relationship between instructional period and instructional practices in the teaching of physics?
(vi) Is there any difference between female and male teachers' use of teaching methods and instructional practices in the teaching of physics?

Methodology

This research adopts a descriptive survey method in the conduct of this research. One hundred teachers were randomly selected from fifty senior secondary schools in Lagos state. Teacher characteristics and instructional practices questionnaire was the main instrument for the conduct of the research. The questionnaire consists of two sections (A & B). Section A deals with teachers' background information and issues related to the type of teachers qualification, attendance of workshops, in-service training and so on. Section B is also subdivided to cater for issues such as teachers' understanding basic physics concepts, required teaching method, skills children are expected to acquire after learning physics and improvisation of instructional materials. Section B consists of thirty-two (32) items which teachers were expected to respond to on a four scale-Likert type of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD).

The questionnaire was subjected to peer-review with two other postgraduate students with specialization in science education. Their comments were included in the final draft. The final draft was then trial tested using ten physics teachers who were not part of the main study. The data collected from the trial test was subjected to reliability test using Statistical Packages for Social Scientists (SPSS) version 14 and an alpha coefficient of 0.85 was obtained. The researchers personally visited the schools and administered the questionnaires and collected same that day. The data collected was coded as: Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1) and was analyzed using means, standard deviation, bar-chart and correlation coefficient.

Results

The results are presented in the tables below:

Table 1: Mean, standard deviation of teachers' characteristics variables

	GENDER	QUALIFICATION	EXPERIENCE	TYPE OF SCHOOL	WORKSHOP	INSTRUCTIONAL PERIODS PER WEEK
NO OF TEACHER	100	100	100	100	100	100
MEAN	1.63	4.45	1.98	1.26	3.00	2.45
S.D	.486	1.436	.992	.443	1.262	.771

Table 1 above shows the mean, standard deviation of teachers' characteristics variables such as gender, qualification, experience, number of workshops/ seminars attended and number of instructional periods per week

The result shows that the mean value of qualified female physics teachers is higher than that of male physics teachers. This means that there more female teaching physics at the secondary schools visited. The experience possessed by both male and female teachers is equal.

Also, there is no discrimination in the area of the number of male and female physics teachers in both public and private secondary schools.
Male physics teachers attended workshops and had more teaching periods than the female physics teachers.

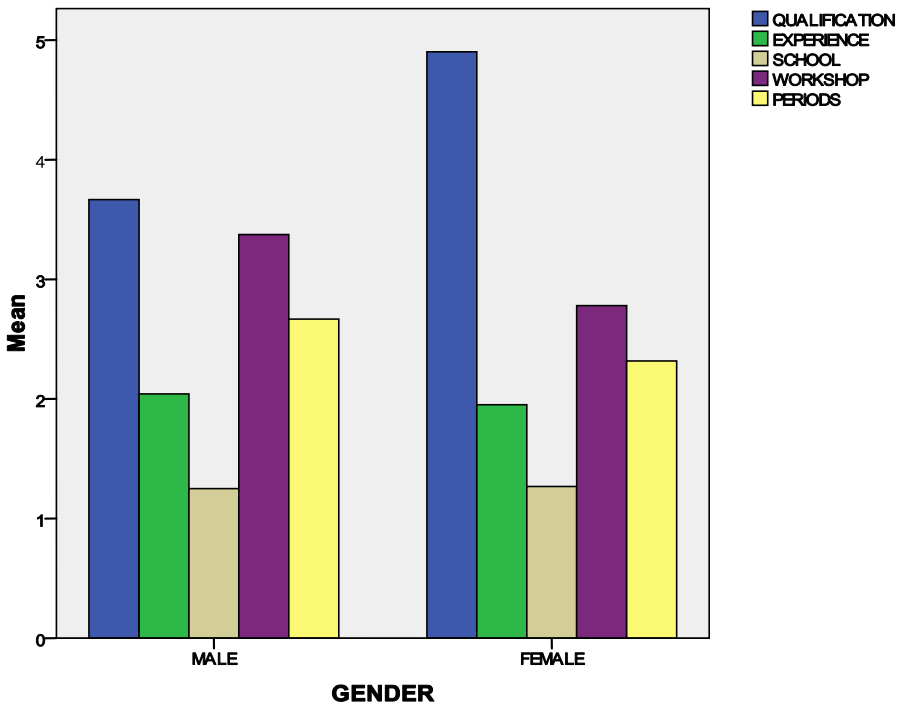

Fig. 1: A bar graph of the mean against gender of qualification, experience, workshop attendance, school- type and number of instructional periods per week.

Table 2: Correlation coefficients and p-values of teachers' characteristics and instructional practices variables as they relate to the teaching of physics

	Knowledge of basic physics Concepts	Teaching methods	Instructional Materials usage	Improvisation in physics teaching
Gender	-.218	.282*	-.143	.169
	(.080)	(.023)	(.254)	(.178)
Qualification	.216	.313*	.192	.264*
	(.083)	(.011)	(.125)	(.033)
Experience	-.313*	-.262	.282*	.120
	(.011)	(.035)	(.023)	(.341)
School type	-.182	.165	-.147	.181
	(.147)	(.190)	(.244)	(.150)
Workshop	.046	.203	-.163	-.234
attendance	(.716)	(.105)	(.195)	(.061)
Instructional	.234	-.283	.118	.312*
Period	(.060)	(.022)	(.351)	(.011)

*Significant at p <.05.

Table 2: shows the Pearson moment correlation coefficient of teachers' characteristics variables as they relate to the teaching of physics. From the table, there is significant correlation between

teachers' gender and teaching method (.282); teachers' qualification, teaching method (.213), and improvisation skills (.264); teachers' experience, knowledge of basic physics concepts (.313), instructional materials usage (.282), Teaching periods and improvisation in physics teaching (.312).

Summary of findings

The study found that:

(i) There is significant relationship between teachers' qualification and instructional best practices in the teaching of physics.
(ii) There is significant relationship between teachers' experience and instructional best practices in the teaching of physics.
(iii) There is no significant relationship between school type and instructional best practices in the teaching of physics.
(iv) There is no significant relationship between teachers' workshop attendance and instructional best practices in the teaching of physics.
(v) There is significant relationship between instructional period and instructional best practices in the teaching of physics.
(vi) There is significant relationship between female and male teachers' use of teaching methods and instructional best practices in the teaching of physics.

Discussion

The results obtained indicated that of all the instructional practices considered, male and female science teachers differ on the teaching methods they use. Okoruwa (1999) found that teacher's gender had significant effect on achievement mean scores of students in science; male teachers were more effective than their female counterparts. This submission could be due to the adoption of active teaching methods by male science teachers.

Qualification of physics teachers has a role to play on the teaching methods adopted by the science teachers. Science teachers with higher qualification are likely to adopt effective and friendlier teaching methods during instruction. Qualification of physics teachers is also relevant on the ability to use instructional materials during instruction. This agreed with the findings of Darling Hammond (2000) which found that teachers quality characteristics such as, certification status and degree in the subject to be taught are very significant and positively correlated with subject outcomes in science and mathematics.

The results further indicated that experienced physics teachers are more knowledgeable on basic physics concepts and also use instructional materials effectively when delivering instruction. Okoruwa (1999) further found out that teachers' teaching experience had significant impact on students' especially in science. This was corroborated by Fettler (1999) who found out that teaching experience as measured by years of service correlated positively with students' test results.

Types of school (public or private) and workshop attendance do not have correlation on science teachers' instructional practices. Though workshop attendance does not have any significance on instructional practices, teacher training through conferences and seminars should be encouraged. The number of times science subjects are allocated in the school time table has also been found to relate to the ability of teachers on improvisation of science materials (David, 2005). This study also found out that instructional periods have positive correlation on the ability of science teachers' ability on improvisation of science materials.

Conclusion

There are no doubts that for Nigeria to participate in a technologically driven economy which all nation of the world are turning to be, teaching and learning of science must be taken serious. Teacher thought processes, both within and out of classroom are very important because they

determine classroom activities. Thus attention must be given to improve their thought processes by improving their basic skills (pedagogy, experience), emotions (in-service training, availability of science equipment and encouragement on improvisation skills) otherwise teaching and learning will be hampered, and the goals of becoming among the technologically developed nations may be a mirage.

Recommendations

Based on the findings, the following recommendations are made:

(i) Physics teachers should be motivated to acquire higher qualification
(ii) Government should employed enough physics teachers to reduce their workload on the ones available
(iii) Only qualified physics teachers should be employed because of the experience required for effective teaching the subject
(iv) Teacher training programmes should be organized regularly for physics teachers in other to catch up with modern trends in teaching the subject effectively
(v) Teachers should be encouraged to engage in research activities which will also enhance their teaching methodology
(vi) School principals should endeavour to make necessary instructional materials available to teachers when needed

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EFFECTS OF AUDIO AND VIDEO COMPACT DISC INSTRUCTIONAL PACKAGES ON STUDENTS PERFORMANCE IN SENIOR SECONDARY SCHOOLS PHONETICS IN MINNA, NIGER STATE

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Abstract
This study investigates the effects of Audio and Video Compact Disc Instructional Packages on the Teaching of Phonetics in Senior Secondary Schools in Minna, Niger State. It examined the significant difference in the post-test achievement scores of students taught using: audio compact disc (ACD); video compact Disc (VCD) and the normal classroom instruction. The sample consisted of sixty (60) senior secondary school students drawn from three equivalent secondary schools within Minna metropolis. The Phonetics Achievement Test (PAT) was administered to students as pre-test and post-test. The results of students were analysed using analysis of variance (ANOVA). Scheffe's test was used for post-hoc confirmation of significant difference. The results indicated that the students taught using Video Compact Disc Instructional Package (VCDIP) and those taught using Audio Compact Disc Instructional Package (ACDIP) performed significantly better than their counterparts taught using the normal classroom instruction. However, there was no significant difference in the post-test scores of male and female students taught Phonetics using Audio Compact Disc Instruction and Video Compact Disc Instruction Packages. These findings indicate that phonetics content could be taught and learnt better through the resourceful integration of Video Compact Disc into phonetics instruction.

Key words: *Oral-English, Phonetics, Audio Compact Disc, Video Compact Disc, Instructional Package*

Introduction

English language is the official language of communication in Nigeria, based on this fact the Federal Government of Nigeria made it a core subject offered by every student from primary to tertiary levels of educational system (FME, 2004). In view of the central position of English Language in the academic, social and economic well-being of the Nigerian student, poor performance in it can be catastrophic, not only to the candidate but also to the society. Deficiency in grammar, lexis and structure and phonetics can be a great limitation to anyone that need to survive in an environment where English is the tool of politics, education, commerce, religion, and information among others (Omojuwa, Timothy & Obiekezie, 2009).

Phonetics which refers to Oral-English is an aspect of English language, which is very important in assessing the performance of the learners. Phonetics concerns the concrete characteristics of the sounds used in languages. Enyeazu (2000) defines phonetics as a systematic study of the sounds of the language and the way in which they are produced. The best way to learn the pronunciation of

the language which is embedded in phonetics is by a systematic study of the sound of the language and initiation of the way in which they are produced. However, native language interferes with pronunciation of English words.

In spite of the importance of this subject to all subjects, reports from the West African Examination Council (WAEC) revealed that students' performance in English Language has been generally poor (WAEC, 2011). The report indicates that most candidates lost all the marks allocated, to grammar, punctuation, spelling and sequence of tenses in their essays because they were unable to handle this aspect of the language correctly. Most of the wrong spellings were traceable to words of similar sounds.

Ayogu (2000) laments that frequent use of lecture method for teaching in Nigeria does not provide for sequence of learning experiences. Ogunleye (2000) reported that technology had not been effectively utilized for teaching and learning in most of the schools therefore it has minimum impact on Nigeria education system. This is because 80% of the teachers in Nigerian are solely using the conventional method of teaching. Educational technologists are of the view that audio and video compact disc instruction has high potential in teaching and learning situation (Abubakar, 2001, & Yusuf, 1997).

Audio disc is the easiest channel for students to listen to variety of speakers on variety of topics in a variety of genres, dialogues, interviews, lectures for receptive skill development. Also, for productive skills, audiotape is the most accessible piece of voice recording equipment and can be used to achieve educational objectives in the cognitive, affective and psychomotor domains of learning (Nworgu, 2000).

Empirical studies in Nigeria involving audiotape and audio compact disc recordings for learning Oral-English have been used by many researchers such as Otegbayo (2005), Adamu (2007) and Kutigi, Gambari and Gana (2010), their findings showed that those taught with audiotape and audio compact disc instructional packages did better than those taught using conventional method. In another study White, Easton and Anderson (2000) found that a combination of audio and print media mode of instruction is more effective than the audio or print mode alone. However, Kareem (2003) found no difference in students' cognitive learning in the use of audio and the conventional methods in college level Biology. Many of these studies were limited to audiotape instruction.

The potential benefits of Video Compact Disc (VCD) cannot be underestimated in the contemporary world. Adams (1990) is of the opinion that videotaped instruction is one of the most influential of all the media for teaching as a result of its to transmit both visual and sound. In the teaching of English language in Nigerian schools, Agusioba (2000) reported that VCD have a strong influence on learning but most teachers seldomly use them because they are not aware of their effectiveness, this has resulted in the continues use of conventional methods of teaching which has not helped in anyway to improve students performance.

Empirical studies on the use of VCD strategy have been mostly limited to the teaching and learning of Sciences, Mathematics and Economics. For instance, Achebe (2005), Gbodi and Laleye (2006), Annie (2007), Gambari and Zubairu (2008), John and Mike (2010), Sani (2011), Ofili and Okore (2012) found that videotape produced better learning outcome when used for teaching home economics, English language, integrated science, practical physics, primary science, instruction of public speaking, chemistry and biology respectively. Their findings also revealed that male and female performed equally better using video instructional packages. Adedapo, Salawu and Afolabi (2004) reported that there was significant difference in the students' cognitive achievement and interest in Economics which were mostly enhanced by the videotape strategy, followed by audiotaped strategy and minimally by the conventional method. However, Ikwuka (2005), Otegbayo

(2005), Adamu (2007) Kutigi, gambari and Gana (2011) among others are the few researchers that carried out study on the effect of videotape, audiotape in English Language in Nigeria respectively. This study examined the effect of audio and video compact disc instruction on the learning of Phonetics aspect of English Language.

The influence of gender in students' academic achievement had been a major concern to educational researchers for long, yet no consistent result had emerged. Ikwuka (2005) in Oral-English, Achebe (2005) in food and nutrition, Gbodi and Laleye (2006) in integrated science, Gambari and Zubairu (2008) in primary science, Sani (2011) in chemistry, Ofili and Okore (2012) in biology among others reported that gender had no significant influence on performance while Otegbayo (2005) reported otherwise. The situation therefore remains the curiosity of researchers to investigate how achievement may be influenced by gender, audio and video compact disc instruction.

Statement of the Problem

The poor performance of Nigerian Senior Secondary School Students in English Language has always excited the educational stakeholders. Students lost substantial marks in the aspect of Phonetics (WAEC, 2011). The causes of students' mass failure have been attributed to many factors, such as: students' inability to write effectively in English Language, inability of English Language teachers to use instructional media in enhancing the quality of teaching, poor teaching methods, lack of language laboratory in schools, and many others (Kutigi,Gambari & Gana, 2010). Several researchers in Nigeria (Ofili, 2012, Dantani, 2011, Adamu, 2007, Orisabiyi (2007), Otegbayo, 2006, Ikwuka (2005) have investigated on the potentials of audio and video instructional packages but none has compare the effects of audio and video compact instructional packages for teaching and learning phonetics.

Purpose of the Study

The main purpose of this study was to investigate the effects of Audio and Video Compact Disc Instructional Packages on the Teaching of Phonetics in Senior Secondary Schools in Minna, Niger State, Nigeria. Specifically, the study was designed to achieve the following objectives:

(i) the effect of Audio Compact Disc and Video Compact Disc on the performance of students taught Phonetics at senior secondary schools in Minna, Niger State.
(ii) investigate the influence of gender on the performance of students taught Phonetics using Audio Compact Disc and Video Compact Disc;

Research Hypotheses

(i) There is no significant difference in the mean achievement scores of students taught Phonetics with VCD instructional package, ACD instructional package, and those taught with lecture method.
(ii) There is no significant difference in the mean achievement scores of male and female students taught phonetics using ACD instructional package.
(iii) There is no significant difference in the mean achievement scores of male and female students taught phonetics using VCD instructional package.

Methodology

The research design adopted for this study was the pretest-posttest experimental control group design. The population for this study was made up of all senior secondary two (SS2) students from school in Minna and Chanchaga local government areas of Niger State. The sample students constitutes 120 (60 males and 60 females) senior secondary class II randomly selected from three secondary schools. In each school 40 students were randomly selected for the study and gender was considered in the selection.

The research instrument was made up of Phonetics Achievement Test (PAT). It was 50-item multiple choice objective test that was validated and its reliability determined as 0.82 using Kuder Richrdson (KR-20). The Audio Compact Disc (ACD) and Video Compact Disc (VCD) instructional packages were jointly developed by the researcher and media specialist. The ACD and VCD were produced after writing the scripts and storyboard. The topics treated were: Vowel sounds; Consonant sounds; Emphatic stress; and Rhytme. All these are from the scheme of work of senior secondary class two.

The teaching was done for four weeks with control group being taught with lecture method and the experimental group I with ACD and experimental group II with VCD instructional packages respectively. The test questions were administered to the students before and after the treatment. Each of the tests were marked and scored accordingly.

Results

The data collected for this study were analyzed using One-way ANOVA statistics and Scheffe post hoc test; and t-test statistics. The One-way ANOVA was used to test hypotheses one while the t-test was employed in testing hypotheses two and three.

To analyze the pretest data the mean scores of the experimental and control groups were computed using the One-way ANOVA. Table 1 presents the result of the One-way ANOVA for the three groups.

Table 1A: ANOVA comparison of the pretest mean scores of the experimental and control groups

Sources of Variation	Sum of Square	df	Mean (X)	F-Value Calculated	P-value
Between groups	6.317	2	3.158	0.218^{ns}	0.805
Within Group	1695.675	117	14.493		
Total	1701.992	119			

ns- Not Significant at 0.05 level of significance

Table 1 shows the result of one-way ANOVA comparison of the mean achievement scores of students of in the experimental groups and control group at pretest. From the table the results revealed that there is no significant difference in the achievement of students in the three groups (F_{cal} = 0.218; df = 119; p > 0.05). This indicates that there was no significant difference between the mean scores of the experimental groups and the control group before the instruction started.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught Phonetics with VCD instructional package, ACD instructional package, and those taught without any package.

To test this hypothesis, One-way Analysis of Variance was used, the result is presented in the table 2A.

Table 2A: ANOVA comparison of the posttest means scores of the experimental group one, two, and control groups

Sources of Variation	Sum of Square	df	Mean (x)	F-Value Calculated	Significance Level

Between groups	6423.317	2	3211.658	70.847*	0.000
Within Group	5303.850	117	45.332		
Total	11727.167	119			

* - Significant at 0.05 level of significance

Table 2A shows the one-way ANOVA results of the mean achievement scores of students of in the experimental groups and control group. From the table, the results revealed that there is a significant difference in the achievement of students in the three groups (F_{cal} = 70.847; df = 119 < 0.05). On this basis hypothesis one is rejected. Therefore, there is significant difference in the achievement scores of senior secondary students taught Phonetic using VCD instructional package, ACD instructional package and conventional method.

In other to ascertain the location of the significant difference between the three groups, Scheffe's Post-hoc test was conducted on the data. The result is shown in Table 2B.

Table 2B: Scheffe's post hoc test on the posttest mean scores of experimental groups I, II, and control group

Variable	Variable (j)	Mean difference (i-j)	Significance Level
Experimental group I	Experimental Group II	10.0500*	0.001
	Control Group	17.8750*	0.001
Experimental group II	Experimental Group I	-10.0500*	0.001
	Control Group	7.8250	0.001
Control Group	Experimental Group I	-17.8750*	0.001
	Control Group II	-7.8250*	0.001

* - Significant at 0.05 level of significance

From Scheffe's post hoc test on achievement of the three groups in table 2B, it can be noted that there is significant difference between the mean scores of experimental group I (VCD) and experimental group II (ACD) in favour of experimental group I. There is also significant difference between the mean score of experimental group I and the control group (conventional method), students in experimental group I perform better than control group. However, there is no significant difference between the experimental group II (ACD) and control group (Conventional method).

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught Phonetics using ACD instructional package.

To test this hypothesis, t-test statistic was used, the result is presented in the table 4.

Table 4: t-test comparison of the mean scores of males and females experimental group II (ACD)

Variable	N	df	Mean (x)	SD	t-value calculated	Significant Level
Male	10		28.80	7.13		
		19			0.35^{ns}	0.471
Female	10		27.55	7.07		

ns - Not Significant at P ≤ 0.05.

From Table 4, the posttest mean score is 28.80 for the male students and 27.55 for the female group. The male score did not differ significantly from the female scores when both were taught Phonetics using ACD instructional package (t_{cal} = 0.35, df = 19, p > 0.05). On this basis, hypothesis 3 was not rejected. Therefore, there is no significant difference between the mean achievement scores of male and female students taught Phonetics using ACD instructional package.

Hypothesis 3: There is no significant difference in the mean achievement scores of male and female students taught phonetics using VCD instructional package.

To test this hypothesis, t-test statistic was used, the result is presented in the table 3.

Table 3: t-test comparisons of the mean scores of males and females experimental group I (VCD)

Variable	N	df	Mean (X)	SD	t-value calculated	Significant Level
Male	10		37.85	6.88		
					0.35^{ns}	0.734
		19				
Female	10		38.60	6.29		

ns - Not Significant at P ≤ 0.05.

From Table 3, the posttest mean achievement score is 37.85for the male students and 38.60 for the female group. The male score did not differ significantly from the female scores when both were taught Phonetics using VCD instructional package (t_{cal} = 0.35, df = 19, p > 0.05). On this basis, hypothesis 3 was not rejected. Therefore, there is no significant difference between the mean achievement scores of male and female students taught Phonetics using VCD instructional package.

Discussion of Results

The results of the one-way Analysis of Variance on the performance of students taught Phonetics using VCD, ACD instructional packages and conventional method indicated a significant difference in favour of the students in the experimental group I (VCD). Scheffe test used as post hoc to locate the observed significant difference indicated that there was significant difference between the achievement of the students exposed to VCD and ACD instructional packages. It is to be noted that students exposed to VCD instructional package did better than those exposed to ACD instructional package. Furthermore, between the experimental group I (VCD) and the control group, significant differences were established in favour of the experimental group I (VCD). However, no significant difference was established between experimental group II (ACD) and control Group.

These findings agree with earlier findings of Achebe (2007) in Home Economics, Gbodi and Laleye (2006) in Integrated Science, Annie (2007) in Practical physics, Gambari and Zubairu (2008) in Primary Science, John and Mike (2010) in Instruction of Public Speaking, Ofili and Okore (2012) and Orisabiyi (2007) in Biology, and Sani (2012) in Chemistry who found that students taught using VCD instructional package produced better learning outcome than their counterparts taught with conventional method. The finding supports the finding of Adedapo, Salawu and Afolabi (2004) who reported that there was significant difference in the students' cognitive achievement and interest in Economics which were mostly enhanced by the videotaped strategy, followed by novel nature of the VCD, audio-taped strategy and minimally by the conventional method. It is possible to infer that the

significant difference observed may be accounted for as a result of power of both sight and sound (Adams, 1990).

The influence of gender on the achievement of students in Phonetics when taught with VCD and ACD instructional packages respectively was examined using hypotheses two and three. The result of the t-test statistic showed no significant gender differences for learners exposed t VCD and ACD instructional packages in the two groups. These findings showed that gender had no influence on the achievement of students in Phonetics whether they were taught with VCD or ACD instructional packages. These findings on gender agree with the earlier findings of Achebe (2007), Ikwuka (2005) in English language, Gbodi and Laleye (2006) in integrated science, Gambari and Zubairu (2008) in primary science, and Kutigi, Gambari and Gana (2010), Ofili and Okore (2012) in biology that students taught with VCD perform equally better. Adamu (2007) reported that gender had no significant influence on achievement of students in Oral-English using tape-recorder while Otegbayo (2005) reported otherwise.

Conclusion

The study showed that the use of VCD have the capability of improving the performance of students in Phonetics than ACD and conventional method respectively. Based on the results, the following conclusions were drawn from the findings of the study:

1. The experimental group one exposed to VCD instructional package performed better than the control group that was not exposed to VCD during instruction.
2. The experimental group one taught Phonetics with VCD instructional performed better than the experimental group two taught using ACD instructional package because they saw and heard.
3. No significant difference was established between students taught Phonetics with ACD instructional package and those taught with conventional method.
4. It can be deduced that the use of VCD and ACD VCD instructional packages enhanced the performance of both male and female students.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Necessary attention should be accorded VCD in the secondary school setting, especially for teaching Phonetics in Nigerian schools.
2. Since the findings of this study showed that students who taught Phonetic with VCD performed better than those taught with ACD instructional package, teachers, textbook writers, and curriculum planners emphasized the use of VCD for teaching and learning at all level of education.
3. Further empirical studies should be carried out on the use of VCD instructional package on different subjects at different levels to provide sound basis for the integration of VCD in Nigerian schools.
4. Language laboratories should be provided and adequately equipped with variety of instructional media such as audio stand videotape recorders, overhead transparencies with projectors containing topics in phonetics, grammar, essay and lexis and structure to improve teaching and learning process.

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