

Original Research Article

Application of Ergonomic Principles on Metal Work Design for Global Utilization in Technical College Classrooms in Rivers State

Wichendu E. Celestine

Abstract

Faculty of Education, Rivers State
University, Port Harcourt, Nigeria

E-mail: zoedu2020@gmail.com /
zebu@gmail.com
Mob. Phne: 08183503395

The study investigated the impact of ergonomics to design metal desk for global utilization in technical college classrooms in Rivers State. The research questions and three hypotheses was formulated to guide the study. The population consisted of 105 respondents, consisted of 36 technical teachers drawn from four (4) technical colleges in Rivers State and sixty nine (69) metal work technicians drawn from the Rivers State Ministry of Commerce and Industry, Port Harcourt. Mean and standard deviation were used to answer the research questions while z –test analysis were used to test the hypotheses. Cronbach Alpha was used to test the reliability of the instrument which yielded 0.93. Five Point Rating Scale was used on the questionnaire. It was found among others increased productivity, reduced error in writing and drawing as benefits associated in the application of ergonomics, mechanical operation, surface finishing, operating cost of products as factors to be considered in designing metal desk. It was recommended that ergonomics should always consider ergonomics or human factors when designing object used by man or students, and government should always consider contractors with necessary design educational qualification for the award of contract of metal desk expected to be used on the technical college classrooms in Rivers State.

Keywords; Ergonomics, Global Utilization, Metal Work Technology, Design, Metal Desk

INTRODUCTION

Technical colleges are established mainly to develop and acquire practical skill for the training of students to knowledge and capacities essential for employment in the industries. Kama (2018) stated that technical colleges are established for training of students to acquire practical skill, knowledge and attitude. Abdulkadir (2011) stated that the major goals of technical colleges are to produce efficient and relevant craftsmen that will promote industrial development in the area of maintenance, production of goods and general services. National Board of Technical Education, NBTE (2008) stated that technical colleges are institutions which are aimed at training and impacting necessary skill leading to the production of craftsmen who will be self- reliant and enterprising in job areas, such as metal fitting, machining,

welding & fabrication. Okorie in Okwelle and Beako (2018) Technical Colleges are established to prepare individual to acquire practical skills and basic scientific knowledge in mechanical craft practice, electrical and maintenance installation, metal work technology among others.

Metal work technology is a trade practiced in technical colleges with the aim to prepare the student to acquire practical knowledge and skills oriented field of study that is expected to equip learners with possible employment opportunities. Adadu, Aho, Nevkar, Reuben and Aminu (2019) stated that in metal work technology, the students are required to design and produced physical 3-dimensional components by understanding the concepts linked to product design, technical drawing and product

layout. He further stated that in doing so, the learner must be able to develop a product idea and take it to the product production that will reduce fatigue and stress on users, and increased productivity for the benefit of the society. A graduate of metal work technology is expected to operate machine and perform other metal work skills like welding, founding, casting, metal forming and fabrication effectively for production purpose in private practices or public industries. Longman (2011) stated that the objective of teaching metal works include to assist students understand, use and handle tools, equipment and machine properly and also help students to identify different properties of metal which aid in selection of materials for a particular job in the workshop. The graduate is also expected to be designed objects ranges from chairs, tables, metal gate, metal desk in accordance with operational guidelines, taken cognizance of the impact of ergonomics in designing these objects to be attractive in its physical appearance, convenience of users, reduced fatigue and stress and to avert accidents.

Metal desk is a seat designed and constructed using iron and wood for student's use. It is used to provide comfort during writing, reading and as seat during or before lesson period. The student used partly as seats and the other part as writing desk where drawing can take place during teaching and learning. Metal desk are duly design and constructed with the aid of a designer who later give it out for construction. In designing metal desk, consideration is giving in ergonomics or human factors in a bit to avert accident and provides comfort to metal desk users in the classrooms. In acknowledging ergonomics or human factors in the design process, construction made easy and comfortable seats that drives home successful academic works will be introduced where reading, writing and drawing will be done with ease with the aid of a perfect design.

Design is the activity that transforms scientific principles to engineering system or product. Wordu (2016) defined engineering design as a decision making process used for the development of engineering systems or assemblies for which there is human needs. Geseckeetal in Wordu (2016) defined design as the ability to combine scientific principles, resources and often existing products into a solution of problem. In this study, design implies to conceive, to innovate, to create metal desk that will be generally accepted and utilize by the teachers and students globally. In most cases a designer may design an entire metal desk or modify existing metal desk in a new way for improve usefulness or human performance globally if consideration is given to ergonomics.

Ergonomics is the scientific application which deals with design, its aesthetic and the common interaction of its parts and structured in accordance to the principles and theories of design.

Abdulrasool, Mishra and Khalat (2010) described ergonomics as the application of psychological and phy-

logical principles to the engineering and designing of products, process and system. It is also seen as the scientific discipline concerned with the understanding of interactions among humans and other elements of system, and the profession that applies theory, principle, data and methods to design in order to optimize human well-being and overall performance of a system. Ergonomics is the process of designing or arranging workplaces, products and system so that they fit the people who use them, Ergonomics aims to improve workplaces and environments to minimize risk of injury or harm. In this study, ergonomics is concern with the process of designing metal desks through a system that will fit the students who use them, provide comfort and convenience that will improves student academic performance and provide conducive learning environment capable to minimize classroom accident, reduce risk of injury or harm in the school environment. Hence, ergonomics has a lot of impact centered on metal desk design with a view to achieve its aims and objectives by enhancing learning in the technical colleges. Through ergonomics, students are acquainted with design for the variability represented in the population, spanning such attributed as age, size, strength, cognition ability, prior experience, cultural expectations and goals. Ergonomists are the only recognized professionals to have competency in optimizing performance, safety and comfort. They help to balance ergonomics with other factors such as aesthetics (how a product looks), the market (what people want to buy), and budget which can determine the quality of the materials and component used to build metal desk for global utilization (Posturite, 2020). Wordu (2016) explained stated that quality of products, environmental condition, human factors, politics, suitable manufacturing processes major factors to be considered in designing a system. He further posits that after design concept has been chosen as the best possible solution for the problem at hand, it must be subjected to a design analysis, analysis of solution, recommendations of parts and their movements are made for global utilization.

Global utilization refers to the general acceptable standards required in carryout design of products, systems for global use. Utilization is the noun form of the verb utilize means to make good use of something. Ogbonna (2016) defined utilization as involves using something especially for practical purposes. Igwe (2019) utilization refers to the application of something to achieve objectives, values and develop interest. Umunadi in Okorieocha, Beako and Omekagu (2019) posited that designers utilized relevant equipment materials, and tools in designing teaching facilitates learning and enhances student achievement in the technical colleges. Therefore, global utilization implies the general usage of designs, structures and acceptable standards used globally. In this study, global utilization refer to the general acceptable standards layout for the design of metal desk or other

structural designs used by students in classrooms in the globe. Student use tables, chair, metal desk, side stool, bench for learning in the classroom, most especially in writing, reading, sitting or carried out practical activities in the laboratory, these objects are not given the desire design outfit that are expected to consider ergonomics or human factors. Hence, it is noticed that untrained designers who failed to comply with the principles of design, ergonomics or human factors, environmental factors, qualification of designers, and other factors required in designing metal desk for student in technical colleges were not carried out. Besides, contract of designing metal desk was not given to expert in designing field. This ugly scenario has made student not to use this desk effectively in writing, reading, drawing or carrying out practical in the school laboratories. It is in the light of the foregoing that the study, impact of ergonomics on metal desk design for global utilization in technical college classroom was investigated.

Statement of the Problem

Ergonomics is a science –based discipline that brings together knowledge from other subjects such as anatomy and physiology, psychology, engineering abilities of people and minimize the effects of their limitation, rather than expecting people to adapt to a design that forces them to work in an uncomfortable, stressful or dangerous way. However, metal desk used in technical colleges posed more stress and dangers to the life of the student. Beako(2018) stated that students sustains various degree of injuries on daily basis, unable to write and draw properly on the metal desk and an unorganized and unsafe seating arrangement which could not allow for a conducive learning in technical college classrooms. This situation had been attributed to sub-standard materials used, poor metal desk design and failure to adapt the principles of design, ergonomics or human factors in carried out the construction of desks for technical college classrooms in Rivers State. Consequently upon this, the study impact of ergonomics on metal desk design for global utilization in technical college classrooms in Rivers State was carried out.

Purpose of the Study

The purpose of the study was to examine the impacts of ergonomics on metal desk design for global utilization in technical college classrooms in Rivers State. Specifically, the study sought to:

- 1) ascertain the benefits associated in the application of ergonomics in the metal desk design for global utilization in technical college classrooms in Rivers State.
- 2) determine factors to be considered in designing a

metal desk for global utilization in technical college classrooms in Rivers State.

- 3) ascertain qualities of a designer required in ergonomics to design metal desk for global utilization in technical college classrooms in Rivers State.

Research Questions

These research questions were posed to guide the study.

1. What are the benefits associated in the application of ergonomics in the metal desk design for global utilization in technical college classrooms in Rivers State.
2. What are the factors to be considered in designing a metal desk for global utilization in technical college classrooms in Rivers State.
3. What are the qualities of a designer required in ergonomics to design metal desk for global utilization in technical college classrooms in Rivers State.

Hypotheses

These hypotheses were formulated and tested on 0.05 level of significance.

1. There is no significant difference in the mean responses of technical teachers of technical colleges in Rivers State and metal work technicians on the benefits associated to the application of ergonomics in the design of metal desk for global utilization in technical college classrooms in Rivers State.
2. There is no significant difference in the mean responses of technical teachers of technical colleges in Rivers State and metal work technicians on the factors to be considered in designing metal desk for global utilization in technical college classrooms in Rivers State.
3. There is no significant difference in the mean responses of technical teachers of technical colleges in Rivers State and metal work technicians on the qualities of a designer required in ergonomics to design metal desk for global utilization in technical college classrooms in Rivers State.

METHODOLOGY

The design used for this study was a descriptive survey. The study was conducted in four Technical Colleges in Rivers State. They includes” Government Technical College, Port Harcourt, Government Technical College, Ahoada, Government Technical Collage, Eleogu and Government Technical Collage Tombia, all in Rivers State. The population of the study consisted of 105 respondents, which comprises of 36 Technical Teachers drawn from four technical colleges in Rivers State and 69 Metal Work Technicians registered with Rivers State Ministry of Industry and Commerce (Field work, 2020).

Table 1. Mean and Standard Deviation of Respondents on the Benefits Associated in the Application of Ergonomics in the Metal Desk Design for Global Utilization

s/n	Benefits of associated with the application of ergonomics in design metal desk	Technical Teachers			Technicians		
		\bar{X}_1	S.D ₁	Remark	\bar{X}_2	S.D ₂	Remark
1	Increased convenience of use in classroom	3.66	1.23	Required	3.90	1.09	Required
2	Reduced errors in writing and drawing	3.84	1.09	Required	3.81	1.14	Required
3	Increased productivity	3.54	1.30	Required	3.64	1.26	Required
4	Enhance certain desirable human values	3.76	1.15	Required	3.89	1.15	Required
5	Improved safety during production	3.66	1.16	Required	3.94	1.02	Required
6	It reduced fatigue and stress on users	3.63	1.22	Required	3.67	0.96	Required
7	It enable the users of the products to be comfortable	3.53	1.31	Required	3.85	1.15	Required
8	It pave ways for greater users/students acceptable	4.00	0.96	Required	3.89	1.06	Required
9	It increased teaching and learning satisfaction	3.79	1.12	Required	3.64	1.13	Required
10	It improved quality of life of users	3.59	1.17	Required	3.84	1.07	Required
Grand Means and Standard Deviation		3.70	1.17		3.81	1.10	

No sampling was taken considering the manageable size of the population. Three research questions were posed to guide the study while three null hypotheses were tested on 0.05 level of significance. Instrument titled "Impact of Ergonomics on Metal Desk Design Technical college classrooms" (IEDDTCC) was developed to elicit information from respondents. The instrument was validated by three experts in the field of Vocational and Technology Education, two from the Department of Vocational and Technology Education, Rivers State University, Port Harcourt, and one from the Technical Education Department, Ignatius Ajuru University of Education, Rumuolumini. The questionnaire consisted of two parts. The first part focused on personal data of respondents while the second part made up of 30 items which based on five Point Likert Rating Scale response of highly Require, Require rarely, Require and not Require. To determine the reliability coefficient of the instrument, a test retest method conducted on five respondents drawn from the Department of Technology Education, Niger Delta University, Yenegoa, Nigeria who were not part of the population. The result of the test was analyzed using Pearson Product Moment Correlation (PPMC). The value of coefficient obtained was 0.93 which implies that the instrument was very reliable and suitable for the study. Out of the one hundred and five (105) copies of questionnaire distributed, One hundred and three (103) was retrieved, analyzed and was used for the study. Mean and standard deviation was used to answer the research questions while the null hypotheses were tested at 0.05 level of significance using Z-test statistical tool. The decision rule for research questions was any item with mean value equal to or greater than 3.50 was required while mean value less than 3.50 was rejected.

Hence, the hypotheses were accepted, when the value of Z-calculated is less than the value of Z-critical and were rejected when the value of Z-calculated is greater than the value of Z-critical.

RESULTS

The data presented in table 1 shows that the mean values ranging from 3.53-3.94 are greater than the criterion mean of 3.50. This implies that the 10-items are required as benefits of ergonomics on metal desk design for global utilization in technical college classrooms in Rivers State. The table further displays that the standard deviations of the respective items are within the range of .96 to 1.31, signifies that their responses are not distance from each other.

Table 2 reveals the mean values ranging from 3.81 to 3.58 which are all greater than the criteria mean of 3.50. This shows that all the items listed are required as factors to be considered in designing metal desk for global utilization in technical college classrooms in Rivers State. The table further displays that the standard deviations of the respective items are within the range of 1.09 to 1.06, signifies that the mean responses are not distance from each other. The results in Table 2 also indicate that the respondents required all the items as indicated on the table 2.

Table 3 shows the mean values ranging from 3.54 to 4.00 which are all greater than the criteria mean of 3.50. This shows that all the items listed are required as the qualities of a designer required in ergonomics to design metal desk for global utilization in technical college classrooms in Rivers State. The table further displays

Table 2. Mean and Standard Deviation of Respondents on Factors to be Considered in Designing Metal Desks for Global Utilization in Technical College Classrooms

S/ N	Factors to be considered in designing metal desks	Technical Teachers			Technicians		
		\bar{X}_1	S.D	Remark	\bar{X}_2	S.D	Remark
11	Environment and in-service condition	3.90	0.92	Required	3.85	1.17	Required
12	Mechanical operation	3.54	1.30	Required	3.99	0.99	Required
13	Quantity of products	3.74	1.14	Required	3.76	1.19	Required
14	Surface finishing	3.84	1.10	Required	3.96	0.93	Required
5	Operating cost of product	3.70	1.21	Required	3.76	1.17	Required
16	Product maintenance requirement and energy cost	3.95	0.95	Required	3.79	1.12	Required
17	Weight and size of metal desk	3.85	1.06	Required	3.85	1.10	Required
18	Cost of production of the metal desk	3.83	1.09	Required	3.85	1.15	Required
19	Availability, condition, qualities and specification	3.78	1.18	Required	4.04	0.87	Required
20	Transportation requirement/delivery date.	3.86	1.06	Required	3.96	0.93	Required
Grand Means and Standard Deviation		3.81	1.09		3.58	1.06	

Table 3. Mean and Standard Deviation of Respondents on Qualities of Designer Required in Ergonomics to Design Metal Desk for Global Utilization

S/N	Qualities of Designer Required in Ergonomics to Design Metal Desk	Technical Teachers			Technicians		
		\bar{X}_1	S.D	Remark	\bar{X}_2	S.D	Remark
21	Designer must have full knowledge of the fundamental physical laws of the basic sciences	4.00	0.92	Required	3.85	1.17	Required
22	He must have a working knowledge of the engineering sciences	3.54	1.30	Required	3.99	0.99	Required
23	Ability to communicate ideas both graphically and orally	3.74	1.14	Required	3.76	1.19	Required
24	He must be grounded in economics	3.84	1.10	Required	3.96	0.93	Required
25	He must have some knowledge of engineering materials	3.70	1.21	Required	3.76	1.17	Required
26	He must be familiar with manufacturing methods and processes	3.95	0.95	Required	3.79	1.12	Required
27	He must have knowledge in computer	3.85	1.06	Required	3.85	1.10	Required
28	He must be able to apply modern equipment and tools	3.83	1.09	Required	3.85	1.15	Required
29	He must be able to explain and analyze drawing	3.78	1.18	Required	4.04	0.87	Required
30	He must be able to solve simple problem in mathematics	3.86	1.06	Required	3.96	0.93	Required
Grand Means and Standard Deviation		3.87	1.09		3.98	1.06	

that the standard deviations of the respective items are within the range of .87 to 1.17, signifies that the mean responses are not distance from each other. The results in Table 3 also indicate that the respondents required all the items as indicated on the table 3.

Test of Hypotheses

Results from Table 4 shows that Z-calculated is -0.622 while Z-critical is 1.96. Based on the analysis, the value

of Z-calculated is less than the value of Z-critical. This indicates that there is no significant difference on the mean responses of technical teachers and metal work technicians on the benefits associated in the application of ergonomics for designing metal desk for global utilization in technical college classrooms in Rivers State.

Results from Table 5 show that the value of Z-calculated is -0.073 while Z-critical is 1.96. This implies that Z-calculated is less than the Z-critical. Therefore, the null hypothesis is accepted. Hence, the researchers concluded that there is no significant difference on the

Table 4. Z-test Analysis on the Responses of Teachers and Technicians on the Benefits Associated in the Application of Ergonomics for the Metal Desk Design for Global Utilization

Respondents	X	S.D	N	Df	α	Z-cal	Z _{cri}	Remark
Teachers	3.70	1.09	36	103	0.05	-0.622	+1.96	Accepted
Metalwork Technicians	3.81	1.06	69					

Table 5. Z-test Analysis of Response of Technical Teachers and Technicians on Factors to be Considered in Designing Metal Desk for Global Utilization

Respondents	X	S.D	N	Df	α	Z-cal	Z _{cri}	Remark
Technical Teachers	3.81	1.17	17	32	0.05	-0.073	+1.96	Accepted
Metalwork Technicians	3.58	1.10	18					

Table 6. Z-test Analysis on the Responses of Teachers and Technicians on the Qualities of Designers Required to Designing Metal Desk for Global Utilization

Respondents	X	S.D	N	Df	α	Z-cal	Z _{cri}	Remark
Teachers	3.79	1.09	36	103	0.05	-0.622	+1.96	Accepted
Metalwork Technicians	3.86	1.06	69					

responses of technical teachers and metal work technicians on the factors to be considered in designing metal desk for global utilization in technical college classrooms in Rivers State.

Table 6 shows that Z-calculated is -0.622 while Z-critical is 1.96. Based on the analysis, since the value of Z-calculated is found to be less than the value of Z-critical, the null hypothesis was therefore accepted. This indicates that there is no significant difference on the mean responses of technical teachers and metal work technicians on the qualities of designers required in designing metal desk for global utilization in technical college classrooms in Rivers State.

DISCUSSION

The study uncovered certain items as benefits associated in the application of ergonomics for the designing of metal desk for global utilization in technical college classrooms in Rivers State. This finding include; it increased convenience of use in the classrooms, reduced errors in writing and drawing, increased productivity, enhance certain desirable human values, reduced fatigue and stress on users, increased teaching and learning satisfaction among others. The findings is in agreement with Adadu, Aho, Nevkar, Reuben and Aminu (2019) who stated that in metal work technology the students are required to design and produced physical 3-dimensional components by understanding the concepts linked to product design, technical drawing and product layout. He

further stated that in doing so, the learner must be able to develop a product idea and take it to the product production that will reduce fatigue and stress on users, and increased productivity for the benefit of the society. The finding further reveals that there is no significant differences in the mean responses of technical teachers and metal work technicians on the benefits associated in the application of ergonomics for the designing of metal desk for global utilization in technical college classrooms in Rivers State.

The finding further identified 10-items as factors to be considered in designing metal desk for global utilization in technical college classrooms in Rivers State. The items are environment and in-service condition, mechanical operation, quality of products, surface finishing, operating cost of products, product maintenance requirement and energy cost, weight and size of metal desks, cost of production, availability, condition, qualities, specification of material among others. The finding is in line with Wordu (2016) who stated that quality of products, environmental condition, human factors, politic suitable manufacturing processes are major factors to be considered in designing a system. He further posits that after design concept has been chosen as the best possible solution for the problem at hand, it must be subjected to a design analysis, analysis of solution, recommendations of parts and their movements are made. The finding also revealed that there is no significant difference in the mean responses of technical teachers and metal work technicians on the factors to be considered in designing metal desk for global utilization

in technical college classrooms in Rivers State.

The study further revealed 10 – items as qualities of designers required to design metal desk for global utilization in technical college classrooms in Rivers State. The items include: designer must have knowledge of fundamental physical laws of the basic science, must have working knowledge of the engineering sciences, ability to communicate ideas both graphically and orally, a learner that was trained using instructional materials among others. The finding consent to the opinion of Umunadi in Okorieocha, Beako and Omekagu (2019) who stated that designer utilization of relevant equipment materials, and tools in designing teaching facilitates learning and enhances student achievement in the technical colleges. The study further revealed that there is no significant difference in the mean responses of technical teachers and technicians on the qualities of designer required to design metal desk for global utilization in technical college classrooms in Rivers State.

CONCLUSION

It is usually convenience, increased production and enhancing teaching and learning when ergonomics or human factors are considered when designing objects used in the classroom. It also provides comfort for learners in the academic environment. Though, weather conditions is also consider to avoid easy decade or rust to the object and it is expedient for designer to inform the users of the necessary materials required in a particular design considering the atmospheric condition of the area. This condition can be determine when a qualified designers with the necessary qualities expected of a designer is identified. Certainly, it is only a qualified designer with required credentials would considers ergonomics or human factors in designing metal desk for student's use in the school. Hence, for the comfort, aesthetic and attractiveness, designer needs to be conscious of ergonomics or human factors in carry out metal desk designs to avert danger or accident in the classrooms.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

- (1) The designer should always consider ergonomics or human factors in designing objects used by man or students.
- (2) That designers should always consider the weather or atmospheres condition in designing classroom objects, e.g. table, chairs, desk to avoid been rust easily.
- (3) That, the government should always consider a contractor with necessary design educational qualification

for the award of contract of metal desks expected to be used in technical college classrooms in Rivers State.

REFERENCES

- Abdulkadir M (2011). Assessment of teaching, learning practices in practical motor vehicle mechanics work at technical college level in Niger state. *Unpublished master's thesis*, Federal University of Technology, Minna, Nigeria.
- Abdulrasool S, Mishra R, Khalat H (2010). *Teachers and students attitudes towards traditional computer assisted blended teaching and learning processes in mechanical engineering subject area. Int. J. Elect. Elect. Eng. (IJEEE)*, 1 (10), 1436 – 1441.
- Adadu Aho KV, Nevkar AD, Reuben JS, Aminu J (2019). Evaluation of the utilization of AutoCAD for instructional delivery in metal work courses in Science and technical colleges in Benue State. *Annals of Technology Education Practitioners Association of Nigeria, ATEPAN*, 2 (2),. 140 – 146
- Beako TY (2018). Workskill needed of undergraduate students of motor vehicle mechanic to maintain clutch assembly in University workshops in Rivers State, Nigeria. *Annals of Technology Education Practitioners Association of Nigeria (ATEPAN)*, 1(2), 149-157.
- Beako TY, Flagg MI, Okorieocha CN, Kooli PL (2018). Effective utilization of power tools by students of metal works in Technical college ownership in Rivers State. *Int. J. Adv. Acad. Res/services, Technol. Eng. 4(1)*, 35-46.
- Igweh UH (2019). Vocational Technical Training: A strategy for self-reliance and national development, *Ebonyi Technology and Vocational Education Journal*, 4 (1), 112 – 119.
- Kama JD (2018). Perceived entrepreneurial skills require it by the graduates of mechanical engineering craft practice of technical college in Nigeria. *Annals of Technology Education Practitioners Association of Nigeria (ATEPAN)*, 1(1), 35 – 43.
- Longman T (2011). Strategies and teaching of metal works in higher institutions. Onitsha: Noble graphic press.
- National Board for Technical Education, NBTE (2008) Mechanical Engineering craft curriculum and modulus specifications: National Technical Certificate (NTC) and Advanced National Technical Certificate (ANTC). UNESCO- Nigeria product .Lagos: NERDE Press.
- Ogbonna GN (2016). Influencing policy implementation factors that impigne quality vocational education in Enugu State. *Unpublished Masters thesis*, Department of Vocational Teachers Education, University of Nigeria, Nsukka.
- Okorieocha CN, Beako TY, Omekagu (2019). Instructional materials availability and utilization for teaching electrical installation in Technical colleges. *Annals of technology education practitioners Association of Nigeria, (ATEPAN)*, 2 (2), 41 – 49.
- Okwelle PC, Beako TY (2018). Emerging technical skills expected of students of motor vehicle mechanic works in the maintenances of transmission system in sustainable manpower development. *International Journal of Education and Social Science Research*, 1(1), 41-48.
- Posturite L (2020). What is ergonomics. Retrieved from <http://www.Posturite.Co.uk> January 28.
- Wordu H (2016). Design process in technical education. *Unpublished lecture note*, Department vocational and technology education. Rivers State, Port Harcourt, Nigeria.