ACTUALIZATION OF PROFESSIONAL DEMANDS THROUGH ERGONOMICS APPLICATION: TECHNICAL MANPOWER PREPAREDNESS

Supported by tetfund TERTIARY EDUCATION TRUST FUND

Azodo Adinife Patrick[1,2]* and Udo Sunday Bassey[3]

[1]Department of Mechanical Engineering, Federal University of Agriculture, PMB 2240 Abeokuta Ogun State, Nigeria
[2]Federal University Wukari, PMB 1020, Taraba State, Nigeria
[3]Department of Industrial Maintenance Engineering, Yaba College of Technology,PMB 2011, Lagos, Nigeria
*Corresponding author: azodopat@gmail.com

Received: December 16, 2016 **Accepted:** March 06, 2017

Abstract: Sustainability, efficiency and productivity of the operational working system of any nation's industrial sector are crucial benefits ergonomics offer in all work settings through enhancing safe work environment and minimizing human errors. Knowledge, awareness and understanding of worker's interaction with the system of one's working environment as it applies to the person's profession and work processes for the general safety, efficiency and well-being, constitute the first step to reduction of work-related injuries. Knowledge and awareness of of the role of ergonomics in engineering real-world of work environment for productivity, accident reduction and personnel's work life preservation was assessed among engineering students undergoing occupational training in a Nigeria based Polytechnic (Yaba College of Technology, Yaba, Lagos). The research tool used for data collection was a self-developed questionnaire adopted after being subjected to reliability test and validation. The same was administered to the participants on individual contact with the researcher in the months of September through to November, 2016. The participants comprise engineering students (N = 287) who were randomly selected from seven (7) Engineering Departments available in the school of industrial and manufacturing engineering in the institution. Analysed data showed that 81.20% of the study participants have no knowledge and awareness of what ergonomics is all about, its benefits and applications in the field of engineering. Therefore, if the professional demands in engineering real-world of work must be achieved, adoption of ergonomics training aspect in the professional work preparation process of engineering students is a necessity.

Keywords: Engineering, ergonomics, safety, training, work, workplace

Introduction

Technical personnel's job demands that an individual worker should be conversant with the work environment, tools, machines and equipment, the operations as well as the applications required of the job. Engineering work environment with its peculiar potential hazardous nature requires good knowledge of safety ergonomics and practices to prevent or minimize workplace accident. Workload in various jobs stresses varied conditions of its performance, work output and strength requirements (human work capacity) in accordance with the job characteristics. Optimum performance level of a worker can be affected by the occupational health hazard in the work environment. In as much as production efficiency is to be achieved this should not be to the detriment of the health and safety of the workforce. The reduction in human suffering alone is reason enough to develop an effective proactive health, safety and ergonomics controlling program (Haag, 1992).

Among the various institutions and establishments that help in the development of workforce in Nigeria is the Polytechnic. Polytechnic education in Nigeria was established to impart the youths with practical and employable skills. This has been found to play a key role in human resource development of the country through creating skilled technical manpower, enhancing the efficiency of the industrial sectors and making living more meaningful and as such enhance and strengthen the nation's technological and industrial development. The distinguishing characteristics of training undertaken in Polytechnics compared to other institutions of higher learning are the strong emphasis on practice-based learning. Training in general provides the means by which performance and well-being of a trainee are enhanced to maximize an organisation's technological input and investment (Karwowski & Marras, 1998). Polytechnic training in conjunction with the work attachment enables students to gain on-the-job experience. However, career training and exposure is more than acquisition of relevant required skill for employability and entrepreneurship (Azodo*et al*., 2016).

Equipping trainees with the appropriate skills, work processes, job-related health and safety issues and human factors transform trainees to proficient workers in terms of performance, productivity and sustainability (Naeinia and Mosaddad, 2013). Health, safety and ergonomics in work environment operate the principles of judicious combination of science and engineering basis as well as complete, detailed and careful understanding of involved human capabilities and limitations (Stobbe, 1996). In addition, Ismaila (2010) stated that ergonomics in general deals with appropriate assigning of personnel to work, based on the person's physical capability and limitations by adjusting the tools, equipment, tasks and work environment. Good knowledge of ergonomics helps in appropriate application and contributes significantly to general well-being and safety of workers at the workplace (Oladeinde, 2015). When properly applied to workplace and tasks, it promotes efficiency of the employees, reduces workers' suffering, improves products and productivity, reduces costs and ultimately contributes to achievement of organizational goals (Stobbe, 1996; Ismaila, 2010).

The compounding effect of an ergonomically deficient workplace for problem which may not cause immediate pain most certainly surpasses the workers' bodies' coping mechanisms thereby causing an inevitable emotional stress, physical symptoms, low productivity and poor work quality (Ayoub, 1990). Cumulative trauma disorders result in injuries to nerves, muscles, tendons, cartilages, ligaments, joints and spinal discs and often present as pains in the upper extremities, neck, back and shoulders (Darragh *et al*., 2008; Kozak *et al*., 2014). Musculoskeletal disorders also known as repetitive stress injuries are increasing work environment health problem, resulting in workers' disability, loss of time, economic and social costs (Franco, 2011; Kozak *et al*., 2014). Reports from the World Health Organisation (WHO) and International LabourOrganisation (ILO) for the year 2000 revealed an estimated figure of 2 million work-related deaths per year worldwide (WHO, 1999). The effect of non-fatal accidents estimated by ILO was over 250 million work absenteeism (Musa, 2003), whereas 2.2 million people die of

work-related accidents and diseases annually (Takala, 2005). Similarly, non-fatal accidents estimates made in Sub-Sahara Africa revealed a total figure of 770,000 per annum and 9,900 per annum for fatal injuries (Leigh *et al*., 1999). The prevailing occupational injury situation in Nigeria in Ezenwa (1997) study revealed that within 3 years interval from 1987 and 1991, industrial workers injuries cases in Nigerian factories reported a total of 2,012 injuries with an annual average of 402.4 accidents. These enormous cases notwithstanding, it is stated that non-reporting of many reportable accidents by factory occupiers' affects the accuracy of the obtained figure as real incidence of occupational accidents, fatalities, as well as the deformities in Nigeria is not well recorded (Musa, 2003; Ezenduka, 2006; Oladeinde, 2015). The peculiar challenges in Nigeria cut across workers in different fields of endeavour as the workers are unaware of the occupational hazards associated with their work environment (El-Megeed *et al*., 1999; Awoyemi, 2003; Ugheoke, 2006).

With the increase in occupational related ailments, there is need to focus on preventive measures (Ezeonu*et al*., 2003). To reduce the predicted rate of occupational injuries, ergonomics awareness for practice must be adopted. As such this study assessed the knowledge and awareness of ergonomics role in engineering field for productivity, accident reduction and personnel's work life preservation among engineering technical manpower trainees in a Polytechnic situated in Nigeria.

Materials and Methods

Items assessed on the questionnaire which was the research instrument used for data collection from the study participants were gender, area of speciality, program (ND or HND), career exposure, students' knowledge and awareness of ergonomics, its application and benefits as it relates to productivity, accident reduction and personnel's work life preservation. In the whole, the questionnaire contains 31 variables. The variables (10) which were used to determine students' knowledge and awareness of ergonomics, its application and benefits as it relates to productivity, accident reduction and personnel's work life preservation were adapted with 'Yes' and 'No' response option. The options are associated with values of 1 for 'No' and 2 for 'Yes' responses. The maximum possible value of score for ergonomics knowledge among the participants for the 10 variables was 20. The response was analysed under two broad categories "Not aware of ergonomics application and benefits" 1 – 10 and "Aware of ergonomics application and benefits" 11 – 20.

Consequently the validation of students' knowledge and awareness of ergonomics, its application and benefits as it relates to productivity, accident reduction and personnel's work life preservation was assessed using 10 variable that demanded participants listing of specific implication and application factors as it relates to the assessed ergonomics knowledge and awareness variables assessed in this study. The participants response were analysed as "correct", "incorrect" and "no response". The questionnaire was self-developed after due consultation and extraction of related information from relevant published and unpublished available sources. The produced copies of the questionnaires were subjected to professional scrutiny by two experts whose advice and recommendations in terms of the study purpose and questionnaire item appropriateness were followed to produce the final copy used for data collection from the participants. This was later pre-tested among engineering students of Federal University of Agriculture, Abeokuta. This helped to ascertain the questionnaire items simplicity and understanding. Appropriate modifications were afterwards effected to the questionnaire items. The study population was 360 engineering students randomly selected from the school of industrial and manufacturing engineering, Yaba College of Technology, Yaba, Lagos, Nigeria. This comprises departments of Mechatronics, Mechanical, Metallurgical, Industrial maintenance, Welding and Fabrication, and Electrical engineering. The institution was considered based on its consistent outstanding records of top ten best polytechnics in the nation. The properly filled and returned questionnaires were analysed.

Prior to administration of the questionnaire, informed consent was obtained from all the participants whose acceptance was demonstrated in filling out the questionnaire. The questionnaire was administered to the participants on the researcher's personal contacts with the participants from the months of September to November, 2016. Descriptive statistics was used to characterise the data obtained in frequency distribution, percentage ratio and cross tabulation formats using statistical package for social science (SPSS) version 16.0. The knowledge and awareness of the students concerning ergonomics, its application and benefits as it relates to productivity, accident reduction and personnel's work life preservation was considered a dependent variable whereas department and programs were considered as independent variables. Pearson's Chi square test was used for test of association and a probability (P-value) of less than 0.05 was considered statistically significant. These were arranged in charts and table

Results and Discussions

A total of three hundred and sixty (360) questionnaires were distributed to the engineering students in the School of Industrial and Production Engineering, Yaba College of Technology, Yaba, Lagos. The distribution proportion of the questionnaire according to program was two hundred and ten (210) questionnaires for National Diploma (ND) students and one hundred and fifty (150) for students in Higher National Diploma programs. The distribution proportion among the students in the two programs for each of the seven departments represented in this study was thirty (30) questionnaires making a total of sixty (60) questionnaires per department besides of Mechatronics, and Welding and fabrication engineering departments which are yet to mount HND program. The response rate of participants' from each of the departments was 6.3 percent (18/30) for Mechatronics Engineering, 25.8 percent (56/60) for Mechanical Engineering, 15.7 percent (45/60) for Metallurgical Engineering, 17.8 percent (51/60) for Industrial maintenance Engineering, 7.0 percent (20/30) for Welding and Fabrication Engineering, 19.9 percent (57/60) for Electrical Engineering and 13.9 percent for Computer Engineering departments (Table 1). The total response in this study is 79.72 percent (287/360). Majority of participants were within the age brackets of 15-20 (63.3%). Overall analysis of participants' gender proportion showed that male students were 91.3 percent (262/287) whereas the remaining 8.7 percent (25/287) were female students. This seems to suggest that more male students take to engineering profession than their female counterparts. A similar observation was made by Azodo (2016) and Azodo *et al.* (2016).

The potential injury exposure in all work setting associated with engineering practices necessitated assessment of ergonomics knowledge among the trainees as all workers interact with the system of their working environment. The prevailing nature of engineering works and its potential hazards demand that trainee(s) under this profession be equipped with not only the fundamental knowledge, ethics and principles of operation, but also worker's relation, human performance, work-related health and safety issues and ergonomics (Azodo *et al*., 2016) as the goal of ergonomics is to reduce the risk of work-related injury at workplaces (Ismaila, 2010). Among the participants assessed in this study

only 24.7 percent (71/287) are conversant with the word "ergonomics". 75.3 percent (216/287) have never come across the word "ergonomics". Response to awareness of what ergonomics is all about showed "Yes" response for 21.3 percent (61/287) and "No" response for 78.7 percent (226/287). Practicability of ergonomic principles according to Oladeinde (2015) is a function of its awareness. Ergonomics awareness helps in ergonomics application and contributes significantly to human wellbeing and safety at workplaces (Grandjean and Kroemer, 1997). Health, efficiency, and well-being of the workers at the workplace can only be effectively promoted if the applications of the principles of ergonomics at work places are done right and timely (Schutte, 2005).

The various sources of information about ergonomics among participants in the study who claimed to be aware of what ergonomics is all about showed media 20(30.8%), discussion with friends and colleagues 4(6.2%), during industrial training 16(24.6%), personal search and reading 21(32.3%), taught as a course in my present study 0(0.0%), and option not included in the questionnaire variables 4(6.2%). This means that knowledge and awareness of ergonomics among the participants is a direct consequence of personal effort as ergonomics as a course is not part of the curriculum taught to the students in the school. It implies that workforce preparation process for the actualisation of professional demands and practices which include training on work setting and workers interact with the system of their working environment for productivity, accident reduction and personnel's work life preservation is deficient of the occupational training being received by the participants.

In various industrial works setting where ergonomics has been applied viz manufacturing, oil, and construction industries, positive impact was recorded (Shikdar and Sawaqed, 2004; Walter, 1985; Mittal *et al*., 2013). The observation made in this study showed that in spite the benefits ergonomics offers to engineering work and work processes in engineering work environment, there was gross dearth of knowledge and awareness of what ergonomics (81.20%) is all about, its benefits and application as it relates to engineering work and work processes in engineering work environment among the participants (Fig. 1).

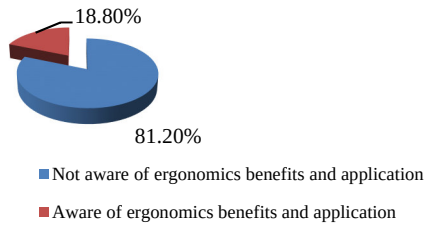

Fig. 1: Ergonomics application and benefits

Validity of knowledge and awareness on ergonomics and work related concepts concerning the work and work processes in engineering as it relates to the participants field of study responses assessed showed that only 41.8% of the participants who claimed to have knowledge and awareness on ergonomics and work related concepts concerning the work and work processes in engineering as it relates to their field of study gave correct response to the application and implication answers to the applicable variables whereas 23.6% did not respond and 34.5% gave incorrect responses (Fig. 2). The operational principle in engineering disciplines and diverse imbedded programs which seems a transitional norm in engineering profession is that most of the graduate become employed in industries and firms, both in private and public sectors, that are involved in production and manufacturing operation where humans has prominent role in every process (Naeinia and Mosaddad, 2013).

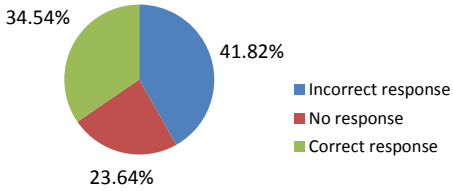

Fig. 2: Validity of ergonomics knowledge and awareness

This they start in the course of their training as work exposure (industrial training). Result obtained in this study showed that all the participants have undertaken their industrial training in various capacities; 59.2 percent (170/287) for 4-months industrial training only and 40.8 percent (54/287) for both 4-months and 1-year industrial training. This showed that the participants in this study have been exposed to occupational training in engineering profession. Industrial training has been found to facilitate training in different professions especially in engineering through personal direct application of basic knowledge in solving practical engineering problems and bridging professional deficiency and gap from the educational institutions (Felder and Brent, 2003; Kartina, 2015). This balances the insufficient theoretical knowledge in producing effective and competent engineering graduates for the real world of work challenges in terms of versatility in professional knowledge and technical skills involved in engineering works and working processes (Ayob *et al*., 2013 and Vítková *et al*., 2013). However, this failed to complement the deficiency on lack of knowledge and awareness on ergonomics and engineering work-related concepts, as was found in the analysed data; Thereby requiring basic knowledge and awareness from educational institutions. The resultant dearth on industrial training program's ability to complement deficiency on lack of information on ergonomics and work-related concepts or reinstated it. This agreed with Naeinia and Mosaddad (2013) who averred that it is the basic and effective role of the educational institution to train engineering students about human beings and work-related health and safety problems. Likewise, this study supported Rogan and O' Neill's assertion that regardless of the tremendous advantages that are associated with the application of ergonomics, adopting and utilising ergonomics benefits observed wide indifference in the industrial sectors of developing nations (Rogan and O'Neill, 1993).

The study also observed that there is no significant difference in the knowledge of the role, benefits and application of ergonomics in work environment among students who have undertaken their industrial training program and those who have not. This observation cuts across different areas of speciality (P = 0.108) and program (ND 2, HND 1 and HND 2) assessed (P = 0.352) (Table 1). Lack of awareness on ergonomics, benefits and application among the participants observation is similar to (Naeinia and Mosaddad, 2013) study on knowledge and awareness about ergonomics which showed dearth of information about ergonomics and its importance among different disciplines in science and engineering in their chosen career. The result obtained in this study is also consistent with Ismaila (2010), who observed that there is deficient knowledge in ergonomics practice in Nigeria.

Table 1: Distribution of ergonomics knowledge and awareness in the department and programs

Characteristics	Variable	Knowledge and awareness of ergonomics		Total	p-value
		No	Yes		
Department	Mechatronic engineering	16 (6.9%)	2 (3.7%)	18 (6.3%)	.108
	Mechanical engineering	50(21.5%)	6(11.1%)	56(19.5%)	
	Metallurgical engineering	33(14.2%)	12(22.2%)	45(15.7%)	
	Industrial maintenance engineering	44(18.9%)	7(13.0%)	51(17.8%)	
	Welding and Fabrication engineering	19(8.2%)	1(1.9%)	20(7.0%)	
	Electrical engineering	38(16.3%)	19(35.2%)	57(19.9%)	
	Computer engineering	33(14.2%)	7(13.0%)	40(13.9%)	
Program	ND 2	143(61.4%)	27(50.0%)	170(59.2%)	.352
	HND 1	46(19.7%)	17(31.5%)	63(22.0%)	
	HND 2	44(18.9%)	10(18.5%)	54(18.8%)	

Conclusion

Occupational training processes in educational institution constitute a significant number of workforces in most nations of the world. Training passed on to the trainees in these programs if effective and adequate are crucial and important in improving sustainability, efficiency and productivity of working systems of the industrial sector of any nation. This study observed high deficiency in the engineering students' knowledge and awareness of role, benefits and application of ergonomics in work environment. As industries are purposefully established to meet various human needs both as reward of effort, or in terms of provision goods and services so do the health, safety and ergonomics at workplace become crucial. It is therefore suggested that educational programs, courses and credits in professional work preparation process of engineering students should consider involving ergonomics training aspect for production of graduate with reliable and practical knowledge about sustainability, optimization human well-being, safety and overall performance of the system.

Acknowledgement

The authors are grateful to the engineering students of Yaba College of Technology, Yaba Lagos Nigeria for their cooperation in participating in this study.

Conflict of Interest

The authors declared no conflict of interest.

Reference

Awoyemi AO &Abdulraheem IS 2003. Occupational Health Problems Associated with Traditional Cloth Weaving in Ilorin, Nigeria. *Sahel Med. J.*, 6(1):6-9.

Ayob A, Osman SA, Omar MZ, Jamaluddin N, Kofli NT &Johar S, 2013. Industrial training as gateway to engineering career: experience sharing. *Procedia-Social &Behavioral Sci.*, 102: 48-54.

Ayoub MA 1990. Ergonomic deficiencies: I. Pain at work. *J. Occupational &Envtal. Med.*, 32(1):52-57.

Azodo AP 2016. Attitude of engineering students towards engineering drawing: A case study. *Int. J. Res. Studies in Edu.*,6(1): 71-84.

Azodo AP, Ismaila SO, Adejuyigbe SB, Mezue TC & Obi SI 2016. Workforce preparation process and safety practices: an aggregate impact analysis. *Engineering Conference and Exhibition AkanuIbiam Federal Polytechnic, Unwana*, 1(1): 377 – 387.

Darragh AR, Harrison H & Kenny S 2008.Effect of an ergonomics intervention on workstations of microscope workers. *Am. J. Occupational Therapy*, 62(1): 61-69.

El-Megeed HSA, El-Din SMA, Kotb SA & El-Oteify MA 1999. A study of burns among workers in Assuit cement factory. *Annals of Burns & Fire Disasters*, 12(1): 16-26.

Ezenduka P. 2006. Occupational health.A course guide for National Open University. 508 pp. 47-122.

Ezenwa AO 1997. Industrial injuries and safety enforcement activities in Nigerian factories.*Nigerian Medical Practitioner*, 33(1/2): 14-17.

Ezeonu FC, Ezeonu JN & Edeogu OC 2003. Occupational hazards in the Nigerian cement industry – Workers' awareness and perception. *African Newsletter on Occupational Health and Safety*,13: 73-75.

Franco G 2011. Health disorders and ergonomic concerns from the use of the microscope: a voice from the past. *American Journal of Clinical Pathology*, 135(1): 170-171.

Grandjean E & Kroemer KH 1997. *Fitting the task to the human: A textbook of occupational ergonomics*. 5th ed. London: Taylor and Francis

Haag AB 1992. Ergonomic standards, guidelines, and strategies for prevention of back injury.*Occupational Medicine (Philadelphia, Pa.)*, *7*(1): 155-165.

Ismaila SO 2010. A study on ergonomics awareness in Nigeria. *Australian J. Basic & Appl. Sci.*, 4(5): 731-734.

Karwowski W &Marras WS (Eds.) 1998. *The Occupational Ergonomics Handbook*.Crc Press.

Kozak A, Schedlbauer G, Peters C & Nienhaus A 2014. Self-reported musculoskeletal disorders of the distal upper extremities and the neck in German veterinarians: A cross-sectional study. *PloS one*, 9(2): 1-9. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089362.

Mittal A, Sharma HK, & Mittal K 2013. Ergonomic risk controls in construction industry-a literature review. *Int. J. Emerging Res. Mgt. & Techn.*, 2: 28 – 33.

Musa O, Bamidele J, Salaudeen A, Saromi H, & Ade OAA 2012. Occupational hazard awareness and safety practices among cement factory workers at Obajana, KogiState, Nigeria. *Elixir Int. J.*, 47(1): 9013-9018.

Naeinia HS, & Mosaddad SH 2013. The role of ergonomics issues in engineering education. *Procedia-Social & Behavioral Sci.*, 102: 587-590.

Oladeinde BH, Ekejindu IM, Omoregie R & Aguh OD 2015. Awareness and knowledge of ergonomics among Medical Laboratory Scientists in Nigeria. *Annals of Medical & Health Sci. Res.*, 5(6): 423-427.

Rogan A & O'Neill DH 1993. Ergonomics aspects of crop production in Tropical developing countries: A literature review. *Applied Ergonomics*, 24(6): 371-38.

Schutte PC 2005.Ergonomics in the South African mining industry.*J. South Afri. Institute of Mining & Metallurgy*, 105(6): 369-372.

Shikdar AA & Sawaqed NM 2004. Ergonomics, and occupational health and safety in the oil industry: a managers' response. *Computers & Industrial Engr.*, 47(2): 223-232.

Stobbe TJ 1996. Occupational ergonomics and injury prevention.*Occupational Medicine (Philadelphia, Pa.)*, 11(3): 531-543.

Takala J 2005. *Introductory Report: Decent Work-Safe Work*. International Labour Office, Geneva.

Ugheoke AJ, Ebomoyi MI & Iyawe VI 2006. Influence of smoking on respiratory symptoms and lung function indices in sawmill workers in Benin City, Nigeria. *Nig. J. Physiol. Sci.*, 21(1-2): 49-54.

Vítková E, Korytárová J, & Hromádka V 2013. Support work experience of students in Civil Engineering. *Procedia-Social & Behavioral Sci.*, 93: 1940-1944.

Walter R 1985. Ergonomics and manufacturing industry. *Ergonomics*, 28(8): 1115-1134.

WHO 1999. Hazard prevention and control in the work environment: Air borne dust. World Health Organization Document, Geneva, pp. 2-3.