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Inappropriate Workspace Anthropometry as a Stressor Affecting Students' Effective Workshop Practice

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----------ABSTRACT ----------

The study tried to find out whether inappropriate workspace anthropometry as a stressor affects students' effective workshop practice. The study used 185 NCE Technical students in 300 Level which consisted of 73 and 112 students from Federal Colleges of Education (Technical), Asaba and Omoku, South-South Nigeria during the 2008/2009 academic session; and no sample was taken. The instrument for data collection was the questionnaire. The reliability of the instrument was 0.87. Data was analyzed with Arithmetic Mean and Standard Deviation; and Z-test at 0.05 level of significance. From the findings, it was the opinion of the students that, inappropriate workspace anthropometry as a stressor led to backache and spinal pains due to arm-reach constraints; shoulder and neck pains due to height constraints; and foot and toe pains due to foot constraints and consequently students' effective workshop practice was affected in terms of lower production quantity and quality; less job satisfaction; and reduced accuracy and speed of job accomplishment; and there was no significant difference in the opinion of the students from Federal College of Education (Technical) Asaba and Omoku on the extent to which inappropriate workspace anthropometry as a stressor affected their effective workshop practice. The recommendation was reduction of the negative effects of inappropriate workspace anthropometry in the school workshop that affected students' effective practice.

KEYWORDS: *Inappropriate, workspace, practice, stressor, stress, constraint, accomplishment, task*

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I. INTRODUCTION

Anthropometry deals with measurements of physical dimensions of workspaces, equipment, furniture and clothing so as to "fit the task to man" and to ensure that physical mismatch between dimensions of equipment and products, and the corresponding user dimensions are avoided (Bridger, 2003); and it remains largely about man and his spatial needs which is aimed at bringing together in convenient form of dimensional and spatial information relative to most human activities (Jones, 2002). The objective of anthropometry and the workspace is to achieve "transparent interface between the user and the task such that the users are not constrained by work height and work surface, and distracted by equipment they are using (Bridger, 2003). Therefore, the workshop environment and its equipment, and furniture layout should be based upon anthropometric information to accommodate most user population since there is no "average worker' in order to create a safe, comfortable and efficient work environment (Wentz, 1999).

Therefore, in any workplace, anthropometric measurements are required in terms of height of knuckles above floor, height of back of the knee above the floor etc (Bridger, 2003). These anthropometric measurements are used to specify furniture dimensions and ranges of adjustments and to determine ranges of clothing sizes; and also dimensions obtained under conditions when the human body is engaged in some physical activity by describing the movement of a body part with respect to a fixed reference point. In any work situation, the user of the space is both in a standing or seating position; and for the work situation to be stress-free, every user should have some personal space since an invasion of the personal workspace may bring about stress. For seated users, design decisions regarding the size and spacing of chairs, benches etc and their proximity to user's personal space requirements influences those aspects of the design with which a user physically interacts (Bridger, 2003). That is, the workstation should be un-obstructive with respect to task performance requirements as well as the anatomical characteristics of the user. For standing workers, bench heights can be specified using data on standing elbow height, together with information about the requirements of the task. If great vertical forces have to be exerted, the working height should be below elbow height.

In lighter work requiring more precision, a higher work surface permits the worker to stand erect, and to stabilize the elbow joints by resting them on the work surfaces (Bridger, 2003). Therefore, standing workers should have enough clear space for the feet so that task related postural movements are not impeded. Human stress due to inappropriate workspace anthropometry in this context occurs when the measurement of physical dimensions of workspaces, equipment, furniture, clothing and products do not suit the corresponding user dimensions or do not 'fit the task to the man'. Most of human stresses occur as a result of physical constraints such as: arm-reach; workspace height, foot and toe; side-work and seating constraints (Basu, Sahu & Datta, (2006). Arm-reach constraints occur when a person works with the hands too high and/or too far away from the task; and this leads to abnormal curvature of the spinal bone (Bridger, 2003). Work-surface height constraint occurs when the work surface is either too low or too high. Work surface that is too low causes the back to be bent over too far; and when too high, the shoulders will be raised above their relaxed posture; and the effect of work-surface height constraint is back muscle strain which can trigger shoulder and neck discomfort (Sanders and McCormick 1993). Foot constraints occur when a worker is standing too far away or too close to the task. That is, the foot position lacks adequate clearance which may lead to foot pain. Working at a corner of a bench may also produce foot constraint when the toe is turned out too much with toe pains as a consequence (Bridger, 2003). Further, side-work constraint occurs when one works at a side rather than directly ahead. Side-work constraint can twist the spine while working in a standing posture which may lead to spinal column problems (Bridger 2003). In addition, improper design of workshop benches, tools, chairs and seats can also contribute to back aches and waist pains (Sanders & McCormick. 1993).

Therefore, where there is inappropriate workspace anthropometry, the seamless interaction between the users of the workplace and the machines, equipment, products, facilities, procedures will be affected. Thus, inappropriate workplace in the workplace will increase errors and safety problems; decrease comfort and user acceptance; and less job satisfaction (Sanders & McCormick, 1993). In addition, injury level will increase; production will become inefficient; and every one suffers (Wentz, 1999). Therefore, failure to effectively apply appropriate anthropometry to enhance synergy between the users of a work space and equipment/machines, and furniture in the workplace lowers production quantity and quality; increases material cost as well as reduces ability to deal with emergencies. Conversely, if the efficiency of machine, equipment, facilities, products, the work environment etc is the result of anthropometric input, the workspace will be safer, easier to use, and satisfying to the user; and the users will also experience less fatigue.

The study, therefore, considered inappropriate workspace anthropometry as a stressor that impinges on the well-being of the users of the workspace while stress is the reaction of the user of a work space to the effect of the stressor (Bell, Greene, Fisher & Baum, 2005). In addition, literature has also established that, consequences of stresses from inappropriate workspace anthropometry are backache and spinal pains, shoulder and neck pains; and foot and toe pains (Bridger, 2003; and Basu, Sahu & Datta, 2006). Further, these stress indicators also affected individuals' task performance in terms of lower production quantity and quality; less job satisfaction; and reduced accuracy and speed of job accomplishment (Sanders & McCormick, 1993; and Wentz, 1999). This therefore, suggests the need to investigate whether inappropriate workspace anthropometry in the school workshop will also affect students' effective workshop practice using the Federal Colleges of Education (Technical), South-South Nigeria for the study.

1.1. Objective of the study

Specifically the study is aimed at determining the extent to which inappropriate workspace anthropometry in the school workshop as a stressor affect students' effective workshop practice. Based on the objective, the following research question will guide the study: What is the extent to which inappropriate workspace anthropometry in a school workshop as a stressor affect students' effective workshop practice? At 0.05 level of significance the following null hypothesis will also be tested: There is no significant difference in the extent inappropriate workspace anthropometry in the school workshop as a stressor will affect workshop practice among students from Federal College of Education (Technical), South-South Nigeria.

II. METHODOLOGY

2.1. Participants

The participants for the study was 185 which comprised 73 and 112 NCE Technical Education students in their 300 Level from the two Federal Colleges of Education (Technical) at Asaba, Delta State and Omoku, Rivers State during the 2008/2009 academic session. The NCE Technical Education is three years training programme leading to the award of Nigeria Certificate in Education (NCE). The 300 Level students were chosen for the study because they offer the entire courses listed in the first and second years of the NCE programme before choosing an area of specialization in third year (NCCE, 1990). The colleges were funded by the Federal

Government of Nigeria with common workshops used for workshop practice. The final year students are expected to have reasonable knowledge of workshop practice. No sample was taken because the population was manageable.

2.2. Instrument for data collection

The instrument for data collection was the questionnaire designed to collect data on students' responses on the extent to which inappropriate workspace anthropometry in the school workshop as a stressor affect their effective workshop practice. The questionnaire had 4 question items in form of statements, and had five (5) response options of Very great extent (VGE), Great extent (GE), Moderate extent (ME), Low extent (LE), and Very low extent (VLE) on a 5-point scale. The students were expected to choose from any of the response options according to how inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice.

The instrument for data collection was face-validated by two professional colleagues who experts in Measurement and Evaluation from the Federal College of Education (Technical), Omoku in order to ensure that question items were adequate and appropriate in addressing the problem and purpose of the study. The reliability of the instrument was tested by using thirty (30) NCE Technical 300 Level students from Federal College of Education (Technical), Umunze during the 2008/2009 academic session who were not part of the study. The college was used for the reliability test because it runs the same NCE Technical Education programme. Further, the students should have a reasonable knowledge of workshop practice and the use of various machines, equipment and power tools. The result of the Cronbach Alpha Coefficient used for testing the reliability of the instrument was 0.87 indicating that the instrument was reliable.

2.3. Data collection and analysis

The data for the study was administered to the 300 Level NCE Technical students at the Federal Colleges of Education (Technical) Omoku by the researcher during the 2008/2009 academic session; while that of Asaba was administered by a trained research assistant who teaches School Workshop Management administered because the course was offered by all the 300 Level students who are expected to be in the lecture when the questionnaire was administered. The students were given a week or the next lecture period (the one that comes earlier) to submit the completed questionnaire to the research assistant. The researcher personally collected the completed questionnaire from the research assistant. Retrieval of questionnaire was 70 copies from students at Asaba out of the 73 copies administered, representing 95.89 percent; and 97 copies from students at Omoku out of 112 copies administered, and representing 86.60 percent.

The arithmetic mean and standard deviation were used to establish the students' responses on the extent to which inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. The hypothesis was tested using Z-test of independent group means at a significance level of 0.05 levels for two tailed test in order to establish whether there was no significant difference in the mean responses of students from the Federal Colleges of Education (Technical), Asaba and Omoku respectively on the extent to which inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. Using a 5-point scale, the decision rule assigned to students' responses were; very great extent, (4.50-5.00); great extent, (3.50-4.49); moderate extent, (2.50-3.49); low extent, (1.50-2.49); and very low extent, (1.00-1.49). In addition, where the calculated Z-test value in the null hypothesis is equal to or greater than the critical table value, reject the null hypothesis and if it is otherwise, do not reject the null hypothesis.

III. RESULTS

The results of the research question the extent to which inappropriate workspace anthropometry in a school workshop as a stressor affected students' effective workshop practice were as presented in Table 1. The stress related behaviours from inappropriate workspace anthropometry in a school workshop as a stressor that was considered in the study were arm-reach constraints (causes back aches), height constraints (causes muscle, shoulder and neck pains), foot constraints (causes foot and toe pains), and seat constraints (causes back pains). The results of the students' Grand Perception Mean **(x_G)** scores of 3.82 and 4.00 for Federal College of Education (Technical), Asaba and Omoku respectively revealed that, it was the opinion of the students from the two colleges that inappropriate workspace anthropometry in a school workshop as a stressor affected their effective workshop practice to a great extent. The Grand Mean Standard Deviations **(x_G)** of 1.19 and 1.01 for the students' response scores from Asaba and Omoku were small, clustered and close to the mean. This revealed that, the students' mean response scores had a small variability and therefore homogeneous

Table 1. Students' mean responses on inappropriate workspace anthropometry as a stressor affecting their effective workshop practice

	Noise stress indicators	Asaba		Omoku		Decision
		X_A	SD_A	X_0	SD_0	
1	Working with hands too high or too far away or not directly ahead of task (arm-reach constraint) causes backaches and spinal pains which affects task performance	3.79	1.31	4.18	0.91	Great extent
2.	Working with work-surface too low or too high (height constraint) causes back, muscle, shoulder and neck pain which affects task performance.	3.99	1.09	4.14	0.96	Great extent
3	Working at corner of work bench too far from or too close to task with inadequate foot clearance (foot constraint) causes foot and toe pain which affects task performance.	3.94	1.12	3.89	1.11	Great extent
4.	Improperly designed workshop stools, benches, etc (seat constraint) causes backaches which affects task performance..	3.56	1.22	3.80	1.07	Great extent
	Grand mean (X_G)	3.82	1.19	4.00	1.01	Great extent

.There was no significant difference in the responses among students from Federal College of Education (Technical), South-South Nigeria on the extent to which inappropriate workspace anthropometry in the school workshop as a stress factor affected their effective workshop practice as shown in Table 2.

Table 2: Z-test for mean response scores of students on inappropriate workspace anthropometry in the school workshop as a stressor affecting their effective workshop practice

Colleges	N	X	SD	Df	P ≤	Z-calculated	Z-critical	Decision
Asaba	70	3.82	1.22	165	0.05	1.01	1.65	Not significant
Omoku	97	4.00	1.01					Ho: not rejected

From the result of the hypothesis, the Z-calculated of 1.01 was less than the table value of 1.65, and the null hypothesis was therefore not rejected at $P \leq 0.05$..

IV. DISCUSSION

From the results of the finding, it was the opinion of the students from Federal Colleges of Education (Technical) Asaba and Omoku that, inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. It was also their opinion that, inappropriate workspace anthropometry as a stressor resulting from arm-reach constraint; height constraint; foot constraint and seat constraint which caused back and shoulder aces and foot strains affected their effective task performance in workshop practice. This finding was consistent with Garg, Bakken & Saxena (1982); and Basu, Sahu & Datta (2006) who reported that, inappropriate workspace anthropometry reduces motion cycle/min in doing jobs, reduces application of required force while carrying out task, and manual performance. Basu, Sahu & Datta (2006) further reported that, motion cycles involved in doing job depends on the anatomical position of the user in relation to height of work surface and adequate clearance of the work surface and the user.

The conditions that affected students' effective workshop practice was due to the fact that, most work tools, equipment seats, stools, workbenches and the general arrangement of workshop facilities are not designed with adjustable ranges to cater for the varying individual sizes, height and arm-reach. Further, the workshop spaces were overcrowded so that it does not allow for enough clearance for the moving anatomy of the students in order to reduce extreme difficulties in standing, sitting and bending postures during workshop practice. In addition, Garg, Bakken & Saxena (1982) observed that, a seat constraint which reduces forward leaning of individuals restricts farther arm-reach leading to performance decrement. The Z-test for the null hypothesis revealed that, there was no significant difference in the responses among students from Federal College of Education (Technical), South-South Nigeria on the extent to which inappropriate workspace anthropometry in

the school workshop as a stressor affecting their effective workshop practice. The implication of this finding was that, the opinion of the two groups of students did not differ on whether inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. Therefore, the consequences of a workshop space characterized by lack of synergy between the equipment, workbenches etc and the students was that arm-reach, height-reach and enough clearance for the moving anatomy of the students was affected, and this in turn also affected their effective workshop practice.

V. CONCLUSION/RECOMMENDATION

From the findings of the study, it was the opinion of the students that inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. Further, the mean responses of the students from the Federal Colleges of Education (Technical), Asaba and Omoku did not differ significantly on whether inappropriate workspace anthropometry in the school workshop as a stressor affected their effective workshop practice. Based on the findings of the study, it was recommended that, the equipment/tools, workbenches etc used in the school workshop should have appropriate interface or synergy with its users to enhance the task performance of students in workshop practice. This is achieved through proper design of workbenches and seats; machines and equipment with adjustable ranges to cater for students of varying sizes, heights etc; and work space envelope (space within which the individual has to carry out activities) should have enough clearance for the moving anatomy of the individual to reduce traffic bottlenecks during workshop practice.

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