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Ergonomic health hazards in selected secondary schools in the Enugu education zone, Nigeria

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ABSTRACT

Introduction

In educational ergonomics, a safe environment that supports teaching and learning activities or processes must be created in all schools. An unsafe teaching and learning environment may precipitate physical health conditions or injuries, impede the teaching or learning process, or restrict ideal activities among users.

Purpose

This study was aimed at examining ergonomic health hazards in selected secondary schools in the Enugu education zone of Enugu State, Nigeria.

Materials and methods

327 teachers selected from a population of 1,800 through the purposive sampling technique were surveyed using a structured questionnaire named, 'Teachers Ergonomic Health Hazard Questionnaire' (TEHHQ). Data were analyzed using mean and standard deviation. The z-test statistic was used to test the hypothesis at the 0.05 level of significance.

Results

The study revealed that the majority of the buildings and teaching and learning facilities were in unsafe conditions in ergonomic terms ($\bar{x}$ = 2.46, SD = 0.66). The study also revealed that the safety provisions were inadequate ($\bar{x}$ = 2.53, SD = 0.73) and there was a gross lack of regular maintenance of facilities and infrastructure in many secondary schools, which accounted for their poor states ($\bar{x}$ = 2.40, SD = 0.59). There was no significant difference between the mean scores of male and female teachers on the ergonomic safety of school buildings and teaching-learning facilities (z_{cal} = 1.32, z_{tab} = 1.96), whereas the difference in the mean ratings of urban and rural secondary schools teachers on ergonomic health hazards, based on location was significant (z_{cal} = 29.58, z_{tab} = 1.96).

Conclusion

There is a need to engage best practices in the (future) structural and functional design and construction of the school environment to meet the comfort and health demands of users.

INTRODUCTION

In the wake of globalization, every aspect of human life has undergone tremendous transformation. Education and educational institutions are vehicles that propel the rapidly changing world and its new ideas and demands, and therefore must constantly and continuously undergo changes and improvement both in its curriculum and learning environment. With the explosion of information and global competitiveness that is ongoing, the nature of teaching and learning is rapidly changing to remain relevant, competitive, and be conformed to the current

dispensation. It has become imperative, therefore, for teaching and learning environments to be designed to fit its users (students and teachers), as teaching and learning cannot take place in isolation of an enabling and safe environment (Ali & Tamrin, 2016). Poor environment and unhealthy lifestyle may lead to bad posture, unsuitable movement patterns, and loss of basic physical skills which can lead to an ergonomic problem among the users (Heyman et al. 2019).

Ergonomics is the science of matching humans' interaction with the proximate environment (Jayaratne, 2012). Jayaratne stated that in an educational set up, ergonomics plays an essential role since it may affect teachers' satisfaction, motivation, and creativity. Ergonomics focuses on the outcomes, such as reducing physical fatigue, aches and pains, and health problems. Ergonomics is aimed at engineering products and the environment to meet the comforts and health of the individuals who are directly involved in their utilization.

Educational ergonomics requires that the school administrator provides an environment that will suit teaching and learning processes as well as ergonomically consider the health and comfort of the key players and its users (teachers and students) (Mayer & Jahnke, 2016).

Giving ergonomic consideration to the school environment reduces the number and severity of Cumulative Trauma Disorders (CTD), lost production time, and restricted duty days (Ismail et al., 2015). A classroom with no seats for the teacher, highly placed chalkboards where the teacher will have to constantly strain to write on it, broken ceilings and leaking roofs of buildings, inadequate lighting provisions, unpolished floors with rough and cracked surfaces, poorly ventilated classrooms or that lack toilet facilities, etc. do not conform to ergonomic standards and is not safe for use by students and teachers, as it will affect their physical health conditions. When work environments are ergonomically designed in such a way that the safety and health of the employees or the users are put into consideration, it will become user friendly and enhance the efficiency of work and productivity (Meyer, 2017).

Rostykus (2014) States that teaching-learning environments must be designed in such a way that learning may proceed with minimum stress and maximum effectiveness.

In the present age of globalization, educational systems all over the world are re-designing and transforming both in content and context and making their education more relevant and competitive to be able to fit into the global environment (Wiker, 2012). Ergonomics works to minimize physical strain on the worker by structuring the physical environment around the way the human body works. The design of chairs and desks to fit posture requirements is very important in teaching and learning places, particularly in the classrooms, offices, laboratories, libraries, etc.

For this work, educational ergonomic which is the science of applying ergonomics to education will be considering only the domain of physical ergonomics of learning environments of secondary schools in Nigeria with a focus on those in the Enugu education zone, Nigeria.

MATERIALS AND METHODS

Research design

The study adopted a cross-sectional survey research design.

Study area

The study was carried out in Enugu education zone, Enugu State, Nigeria. Enugu Education zone is made up of three (3) Local Government Areas, which are Enugu North, Enugu East, and Isi-Uzo Local Government Areas (Enugu State Post Primary Education Board [PPEB], 2019).

There were one thousand eight hundred (1,800) teachers in the thirty-one (31) secondary schools in Enugu education zone at the time of this survey (PPEB, 2019).

The population of the study

The population of the study comprised of one thousand eight hundred (1,800) teachers in the thirty-one (31) secondary schools in Enugu education zone. This population is made up of one thousand and ten (1,010) females teachers and seven hundred and ninety (790) males teachers (PPEB, 2019).

Sample size and sampling technique

A sample of 327 teachers, determined using Taro Yamane statistical techniques was used for the study. Sampling was done in three stages. Stage one was the clustering of the zone into three, based on the Local Government Areas. Stage two was purposive sampling. We drew six schools from each cluster to have eighteen (18) schools. Stage

three was systematic, drawing of eighteen (18) teachers from each of the eighteen (18) schools to produce 327 teachers who served as the sample for the study.

The instrument for data collection

The instrument for data collection was a structured questionnaire named 'Teachers Ergonomic Health Hazard Questionnaire' (TEHHQ). The instrument was validated by three experts. A test-retest method was used to test the reliability of the instrument. Cronbach Alpha was used to determine the internal consistency of the instrument. A reliability value of 0.83 was obtained.

The instrument was developed on a four (4) point Likert-type scale of VHE, HE, LE, and VLE respectively; and the respondents were asked to indicate the degree of their agreement with each item by ticking one of the four options.

Data analysis

Data were analyzed using mean and standard deviation. The response options were assigned values of 4, 3, 2, and 1 respectively. The limit of real numbers was used to decide the answer to the research questions.

The z-test statistic was used to test the null hypotheses at the 0.05 level of significance.

RESULTS

Results of the study indicated that items 1, 3, 4, 5, 6, 7, 8, 9, 11, and 13 on table 1 were considered ergonomically unsafe for teachers while items 2, 10, and 12 on the same table were considered safe. This result shows that buildings, computer rooms, libraries, toilets, work chairs and tables, machines and equipment rooms, and ICT Centre were ergonomically unsafe for teachers' use while carrying out their teaching duties. This may be due to poor designs of the facilities during construction. The grand mean of the responses of teachers on the safety of buildings and learning facilities were $\bar{x}$ =2.46, SD=0.66 (Table 1).

Table 1
The extent to which Ergonomic Safety consideration of school buildings and teaching-learning facilities affect teachers

S/N	Facilities	Mean	SD	Decision
1	School buildings	2.41	0.66	LE
2	Classroom blocks	2.51	0.82	HE
3	Teacher's offices	2.40	0.66	LE
4	Laboratories	2.48	0.72	LE
5	Teacher's common rooms	2.44	0.68	LE
6	Libraries	2.48	0.72	LE
7	Computer rooms	2.30	0.56	LE
8	Toilets (conveniences)	2.26	0.53	LE
9	Work chairs and tables	2.41	0.66	LE
10	Classroom environment	2.65	0.89	HE
11	Machines and Equipment rooms	2.44	0.68	LE
12	Stairways and walkways	2.56	0.85	HE
13	ICT centre	2.46	0.70	LE
	Grand mean	**2.46**	**0.66**	**LE**

KEY: VHE = Very High Extent, **HE** = High Extent, **LE** = Low Extent, and **VLE** = Very Low Extent

The Results also showed that classroom and practical lesson ergonomics safety provisions have mean scores of 2.82 and 2.51, and SD of 0.86 and 0.79 respectively while the library ergonomics settings, Laboratory ergonomics, and Others (teacher's offices, conveniences, space, lighting walkways, stars, computer rooms, ICT centers, etc), had a mean rating of 2.48, 2.42 and 2.40, and SD of 0.72, 0.68 and 0.60 respectively. Classroom and practical lesson ergonomics safety showed a 'high extent' of ergonomic safety provisions, while library ergonomics settings, laboratory ergonomics, and others, showed a 'low extent' to ergonomic safety provisions. The grand mean of the responses of teachers on the extent to which ergonomic safety provisions are available in the building and teaching-learning facilities of secondary schools were $\bar{x}$ = 2.53, SD = 0.73 (Table 2).

Table 2
The extent to which ergonomic safety provisions are available in the building and teaching-learning facilities of secondary schools

S/N	Attributes	Mean	SD	Decision
1	Classroom Ergonomics: (space seat and seating arrangement, location, lighting, colour, chalkboard, projector, noise –level, ventilation (etc.)	2.82	0.86	HE
2	Laboratory ergonomics: (dark room, furnaces, fume cupboards, windows, workbenches, and tabletops, air –condition, fans fire extinguisher, ventilation storage facilities for chemicals, lighting, noise –level, seats, etc.).	2.48	0.72	LE
3	Practical lessons ergonomics: (safety shoes, overalls, gloves, goggles, ear –muffs, ventilation firefighting equipment, sporting equipment, agricultural tools, etc.)	2.51	0.79	HE
4	Library settings and ergonomics: (location, easy access, display settings, noise – level, ventilation, convenience, lighting, colour, seat arrangements, space ancillaries, etc.).	2.42	0.68	LE
5	Others (teacher's offices, conveniences, space, lighting walkways, stars, computer rooms, ICT centers, etc.)	2.40	0.60	LE
	Grand mean	**2.53**	**0.73**	**HE**

KEY: VHE = Very High Extent, **HE** = High Extent, **LE** = Low Extent, and **VLE** = Very Low Extent

Results of the analysis in Table 3 shows that school buildings, classrooms, and practical lesson halls has a mean score of 2.43, and an SD = 0.68, laboratories has a mean score of 2.47, and an SD = 0.71, practical lessons and its settings has a mean score of 2.36, and an SD = 0.48, libraries has mean score of 2.41, and an SD = 0.65 and others (offices, conveniences, lighting, walkways, stairs, computer room, ICT centres, etc.) has a mean score of 2.33, and an SD = 0.45, respectively. The table also shows that all the above items fall below the criterion scale of 2.5 (LE), signifying that the regularity of maintenance of the secondary school buildings and teaching-learning facilities in the Enugu education zone is not assured. Findings in Table 3 also indicated that the grand mean of the responses of teachers on the extent of maintenance services of buildings and teaching-learning facilities of secondary schools were $\bar{x}$ = 2.40, SD=0.59.

Table 3
The extent of the maintenance service of buildings and teaching-learning facilities of secondary schools

S/N	Attributes	Mean	SD	Decision
1	Buildings, classrooms, and Practical Lessons halls	2.43	0.68	LE
2	Laboratories and their settings	2.47	0.71	LE
3	Practical Lessons and its settings	2.36	0.48	LE
4	Libraries	2.41	0.65	LE
5	Others (offices, conveniences, lighting, walkways, stairs, computer room, ICT centres, etc.)	2.33	0.45	LE
	Grand mean	2.40	0.59	LE

KEY: VHE = Very High Extent, **HE** = High Extent, **LE** = Low Extent, and **VLE** = Very Low Extent

Table 4 presents the z–test difference of the mean scores of male and female teachers on the ergonomic safety of school buildings and facilities. The result shows that there was no significant difference between the mean scores of male and female teachers (z_{cal} = 1.32, z_{tab} = 1.96).

Table 4
Z-test comparison of the mean ratings of the significant difference between males and females secondary schools teachers on the ergonomic safety of school buildings and teaching-learning facilities

Source Variable	N	Mean	SD	df	z-cal	z-critical	Decision
Females	237	2.27	0 .45				
				316	1.32	1.96	Reject
Males	90	2.46	0.58				

The ergonomic health hazards among teachers do not depend on location. There was a significant difference between urban and rural secondary schools teachers on ergonomic health hazards, based on location (z_{cal} = 29.58, z_{tab} = 1.96) (Table 5).

Table 5
Z-test comparison of the mean ratings of the significant difference between urban and rural secondary schools teachers on ergonomic health hazards, based on location

Source Variable	n	Mean	SD	df	z-cal	z-critical	Decision
Urban	237	2.23	0.51				
				316	29.580	1.837	Reject
Rural	90	2.49	0.57				

DISCUSSION

The study revealed that the majority of the buildings and teaching and learning facilities were in unsafe conditions in ergonomic terms. This finding confirmed the statement of Uche et al. (2011) in which they observed that infrastructural development in secondary schools was of low quality and most times are not teacher-friendly, especially in rural areas. School infrastructure such as the classrooms, practical lesson halls, offices, computer rooms, toilets among others, are not safe for teachers' use. This means that the facilities do not conform to ergonomic standards. When teaching and learning take place under ergonomically unsafe environments, the teachers are faced with ergonomic health challenges which lead to teachers' absenteeism and poor productivity, as stated by Ismail et al. (2015). In a situation where educational activities cannot take place effectively due to the state of the environment and inadequate infrastructure, productivity would be hampered or the realization of educational goals would be impaired. This finding is also supported by a statement in the report of the committee on vision 2030 of the IET, which claimed that secondary school education has experienced phenomenal expansion without a proportionate increase in funding and facilities (International Ergonomics Association [IET], 2015). The system suffers from problems such as outdated, dilapidated, or non–existent infrastructure, poorly stocked libraries, inadequate laboratories, and poor conditions of services, prompting educational brain drain" (Odejele, 2012).

The state of infrastructure as well as teaching-learning facilities in schools cannot be delineated from the politics behind the establishment of most of them. Educational objectives of schools can only be achieved when the teaching and learning environment and facilities are structurally and functionally designed to meet the comfort and health demands of the users (Burke & Sarpy, 2014)

The study also revealed that most of the teaching and learning facilities did not meet ergonomic considerations and provisions for safety were inadequate. From the results, it was evident that most of the facilities did not conform to ergonomic standards. Again, this is an issue that can gravely affect the health of teachers and thus, the outcome of educational endeavours, which then adversely affect the performance of teachers, as they begin to develop one health challenge after another, as inferred by Lavack & Magnuson (2015). This problem can be avoided if ergonomic considerations are given to the design of the educational environment and teaching-learning facilities from the onset. This finding is supported by the assertion of an ergonomics event in 2010 by the International Ergonomics Association, which states that ergonomic planning and designing of schools and facilities can help reduce cost and improve the safety of the end-users (IET, 2015). According to IET, some of the benefits of a user-centred approach to the design of learning environments include lower injury and accident rates, faster learning times, fewer errors, easier maintenance, a general increase in job satisfaction, less absenteeism, increases in productivity amongst others. In line with this, Kim & Jung (2016) observed that to sustain a workforce, it has become important to ensure a hazard-free and safe working environment and that this should be embraced by managers since a safe working environment can result in greater efficiency and productivity.

The findings of this research also revealed a gross lack of regular maintenance of facilities and infrastructure in many secondary schools, which accounted for their poor states. Some school buildings and facilities which may have been given little ergonomic considerations, though not adequate in their design at the initial time, became degraded over time due to over-use and lack of proper and regular maintenance, and have been rendered unsafe for use. This finding is supported by the findings of Asiabake (2018) who stated, in the study conducted to find out the effectiveness of school facilities, that physical facilities in schools are not fully utilized due to poor maintenance and inadequate facility planning. According to Asiabake, poor initial planning brings about a reduction in educational quality and contributes to students' poor academic achievement.

The sight of some of the buildings and facilities leaves much to be desired, with classrooms looking bare and empty. No seats, leaking roofs, rough fences, inadequate lightings, broken windows and doors, no seats and desks or tables, overcrowding, and the likes are some of the features of these buildings and facilities. Physical observation also revealed very few functional buildings and an array of uncompleted or dilapidated or abandoned building projects. The few completed ones have become poor in shape, probably, due to over-use as a result of over-population ("Field Observation", n. d.).

A classroom, which is meant for about 30 to 40 students, is forced to take 60 to 75 students or more, and most times with poor seating facilities, which at times, results from the jagged and sharp edges of broken seats and tables ("Field Observation", n. d.). This poses threats of injury to users. Many facilities like equipment, furniture, laboratories, workshops, libraries, audiovisual rooms, computer rooms, projector rooms, teacher's offices, etc. lacked safety and ergonomic standards, yet, these are institutions of learning where the future economic planners and development officials of the country are expected to be bred.

CONCLUSIONS

The Ergonomic consideration of physical teaching and learning facilities constitutes major determinants of the success of teaching and learning. It is therefore very pertinent that priority is given to the provision of proper design and planning of the educational environment so that the key factors in educational processes can effectively play their roles. The teaching-learning facilities in the secondary schools in the Enugu education zone, as the findings of this research revealed, were not ergonomically conceived in terms of standards and specifications, and many facilities are not adequately maintained. There is, therefore, a need to engage best practices in the (future) structural and functional design and construction of the school environment to meet the comfort and health demands of users.

RECOMMENDATIONS

1. Government and Educational planners should ensure that appropriate and pragmatic strategies are adopted in schools to improve the teaching and learning environment, particularly, to see to it that facilities are conformed to ergonomic standards.
2. The government should allocate more funds and resources to schools to enable expansion of facilities, repair, and maintenance of already existing but dilapidated infrastructure and to ensure that safety provisions and procedures are made and adhered to in laboratories and workshops. All necessary places and facilities should be regularly maintained by those at the helm of affairs.
3. Training and awareness programs should be organized by school administrators for staff on ergonomics issues, as it pertains to their job descriptions and usage of the learning facilities. Best practices should be encouraged.
4. Ergonomic experts should be consulted by school administrators to identify ergonomic issues that hamper employees' job delivery and students' effective learning.

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