

Indoor Air Pollution in the School Workshop as an Environmental Stressor Affecting Students' Effective Workshop Practice

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Abstract: *The study investigated indoor air pollution in the school workshop as an environmental stressor affecting students' effective workshop practice. 183 NCE Technical students in 300 Level which comprised of 73 and 112 students from Federal Colleges of Education (Technical), Asaba and Omoku, Nigeria respectively during the 2008/2009 academic session was used for the study. The Indoor Air Pollution Stressor and Performance Questionnaire (IAPSPQ) were used to collect data. Reliability of the instrument was 0.99; and the Arithmetic Mean, Standard Deviation; and the Z-test at $P \leq 0.05$ was used to analyze the data. Stresses caused by indoor air pollution in the school workshop had negative effect on students' effective workshop practice; and no significant difference was established in the mean responses of students from the two colleges with respect to the extent indoor air pollution in the school workshop as an environmental stressor affected their effective workshop practice. It was recommended that, stresses from indoor air pollution in school workshops which had negative effect on students' effective workshop Practice should be mitigated.*

Keywords: *Task, Workshop, Vibration, Stressor, Stress, Equipment/Tools, Performance, Practice, Perceive, Effective*

I. Introduction

The Nigerian Certificate in Education (NCE) Technical programme is a three year post secondary education aimed at providing technical teachers with intellectual and professional background adequate for teaching technical subjects and to make them adaptable to any changing situation in technological development not only in the country but in the world at large (National Commission Colleges for Education [1]. However, the philosophy of the NCE Technical programme has not been able to achieve its aim of accelerating scientific and technological development because of lack of foresight on the part of policy makers in terms of providing the enabling environment. This has made the road to true technological advancement seemingly an uphill task by all standards. This is because, the needed manipulative skills required of NCE Technical graduates has been elusive. It is when students in technology and vocational training are exposed to effective workshop practice as opposed to only theoretical teaching, that some of the aims of the NCE Technical programme will be achieved. Students exposed to effective practical training will utilize the knowledge they acquired in the school workshop for their future employment in industries or factories especially those that manufacture goods and products related to their area of specialization while at school. That is, the practical training received by students in the workshop should be able to compare with that of the industry where the trainee will subsequently work [2].

The need for students to acquire adequate and effective workshop practice has generated a lot of concern among technology and vocational teachers. This concern has necessitated research work over the years on the problems affecting effective workshop practice in technology and vocational education. The reasons for lack of effective workshop practice and appropriate manipulative skill of students in schools have been attributed to teachers' instructional method; inadequate workshop spaces; equipment/tools and training materials; the qualification and competence of the teacher [2, 3, 4, 5, 6].

However, in some colleges where there are competent and qualified lecturers who have sufficiently engaged their students in workshop practice; the students still record poor performance in practical work. This suggest that other factors apart from availability of equipment/tools, training materials, workshop and laboratory spaces, and adequate supply of qualified lecturers are responsible for lack of effective students' task performance in workshop practice.

The study, therefore, considered whether indoor air pollution in the school workshop as an environmental stressor will affect students' effective workshop practice. The school workshop space or any other industrial set-up which accommodates its users could be affected by indoor air pollution [7, 8]. When the school workshop space is characterized by indoor air pollution during workshop activities, it will impinge on the

users of such space in a negative direction. When the users are unable to withstand the effect of indoor air pollution, they exhibit stress behaviours such as mental and physical fatigue, restlessness, muscle weakness, back and shoulder ache, etc [7, 9]. In this study, indoor air pollution that is likely to impinge and threaten the well-being of a person is considered as a stressor while stress is a reaction to the effect of the stressor on individuals [8]

The word pollution came from the Latin word *pollutus* which means made foul, unclean, or dirty [10]. Air pollution is the contamination of the open (ambient) air outside our structures [11]; or any atmospheric condition in which gaseous and particulate materials or substances are added to the atmosphere by the activities of man in such concentrations sufficient to produce undesirable, unwanted or harmful effects on man and his environment [12, 13, 14]. In addition, any atmospheric condition in which substances exist at concentrations higher than normal background or ambient levels is said to be polluted if it has measurable effects on humans, animals, flora or materials [15]. Indoor air pollution may also occur when the atmospheric conditions contain certain substances in such concentration that they can produce undesirable effects on man and his environment [13]. All buildings enclose a finite volume of air and the air quality is likely to deteriorate if not properly ventilated. The concentrations of pollutants inside houses are usually higher than those outside because our indoor activities generate particles [11]. But, some air pollutants such as carbon monoxide though harmful are not detectable in those ways because they are odourless and colourless [8].

The main sources of indoor air pollution as an environmental stressor occur externally when air enters the building from outside. The building fabric itself may be a source of pollution emitted by construction materials, furniture and fittings; and also from the occupants themselves who give off carbon-monoxide, water vapour, dead skin cells, and unpleasant odours. Manufacturing activities is also a source of indoor air pollution and it arises when there is wear and tear of exposed part of surfaces, or frictional activities [16, 17]. The operations that generate indoor air pollution are metal casting, crushing and grinding; screening, saving, polishing and spray finishing; fabric sewing, forging and welding smoke; woodworking dusts, drilling operations etc.

Observable stresses when individuals are exposed to indoor air pollution are sensitivity to odour (restlessness), eye irritation (inattentiveness), skin irritation (restlessness and inattention), and respiratory irritation (coughing and sneezing) [8]. Indoor air pollution stress affects task performance in terms of reaction time, time judgement and motor or manual control [7]. Eye irritation when hydrocarbons and photo-oxidants are emitted from polish finishing, welding smoke and heat from furnace during forging [8, 12, 18]. In addition, skin irritation rashes and burns are caused by arsenic produced by furnaces, welding and spray finishing [8].

Further, certain particulates when swallowed or ingested can cause respiratory or nose irritation. The effect is that, the pollutants will interfere with respiratory functions and possibly contributes to bronchitis, pneumonia and asthma [12, 14, 18]. Sneezing and coughing is also a result of nose irritation when fine particles from saw dust, spray finishing and polishing activities are inhaled [18, 19]. Persons exposed to indoor air pollution can be affected by Air Pollution Syndrome (APS) when human health problem cannot be associated with a particular pollutant. APS is caused by a combination of pollutants and characterized by headache, fatigue, insomnia, dizziness, nausea, and drowsiness [12, 14, 18].

A polluted indoor space affects task performance negatively when the pollutants are of high concentration. Exposure to air pollution at some concentration in a room space impairs performance on time judgement tasks [8]. Poor indoor air quality especially the presence of carbon monoxide (CO) adversely affects human reaction time, manual dexterity and attention leading to performance decrement [8]. In addition, stuffy and poorly ventilated workspace makes the occupants sensitive to various odours; and sensitivity to odours usually amplifies employees' low morale, job dissatisfaction and negative responses to work attitude thereby causing performance decrement.

However, no two individuals react in the same way to stresses from indoor air pollution in the same workshop space due to variation in age, state of health, physical activities, physique of the individual and the degree of acclimatization. The degree to which the indoor air pollution will affect the individuals' task performance also varies according to the intensity and ability of the individual to withstand stresses induced by the stressor. From the foregoing, research has established that indoor air pollution affected individuals' task performance negatively. It was therefore pertinent to determine whether indoor air pollution in school workshop as an environmental will also affect students' effective workshop practice.

As a guide, the study shall find answer to the following research question: To what extent will indoor air pollution in the school workshop as an environmental stressor affect students' effective workshop practice? Based on the purpose of the study and research question, the following null hypothesis will be tested at 0.05 level of significance: There is no significant difference in the responses among students on the extent to which indoor air pollution in school workshop as an environmental stressor will affect their effective workshop practice.

II. Method

2.1 Participants

A total of 185 NCE Technical students in their 300 Level which comprised 73 and 112 students from Federal Colleges of Education (Technical) at Asaba, and Omoku respectively during the 2008/2009 academic session were used for the study. 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 their 300 Level [1]. 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 Measures

The instrument for data collection was the Indoor Air Pollution Stressor and Performance Questionnaire (IAPSPQ) made up of four question items designed to elicit students' response on the extent to which indoor air pollution in school workshops as an environmental will affect their effective workshop practice. Each questionnaire item in form of statements had five response options of Very great extent (VGE), Great extent (GE), Moderate extent (ME), Low extent (LE), and Very low extent (VLE) using the 5-point scale and was rated 5, 4, 3, 2 and 1 respectively. The students were expected to choose from any of the options according to how they perceive indoor air pollution as a stressor affecting their effective workshop practice.

The IAPSPQ instrument was face-validated by professional colleagues at the Federal College of Education (Technical), Omoku to ensure that the items in the questionnaire were clear in wording, adequate and appropriate in addressing the purpose of the study. The reliability of the instrument was tested using thirty, 300 Level NCE Technical students from the Federal College of Education (Technical), Umunze, Anambra State, Nigeria during the 2008/2009 academic session who were not part of the study. The college was used for the test because it runs the same NCE Technical Education programme. The Cronbach Alpha Coefficient test result was 0.99 indicating the reliability of the IAPSPQ instrument.

2.3 Procedure

The Indoor Air Pollution Stressor and Performance Questionnaire (IAPSPQ) were administered to the 300 Level NCE Technical students at the Federal Colleges of Education (Technical), Asaba and Omoku. The questionnaire for Omoku was administered by the researcher while a trained research assistant who teaches School Workshop Management administered that of Asaba because the course is offered by all NCE third year 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 Asaba out of the 73 copies administered, representing 95.89 percent; and 97 copies from Omoku out of 112 copies administered, representing 86.60 percent.

The Arithmetic mean and standard deviation was used to establish the extent to which indoor air pollution in the school workshop as an environmental stressor will affect students' effective workshop practice. The null hypothesis was tested using Z-test of independent group means at 0.05 level of significance for two tailed test to establish whether there is no significant difference in the responses among students from Federal College of Education (Technical), Asaba and their counterparts from Omoku on the extent to which indoor air pollution in school workshop as an environmental stressor will affect their effective workshop practice. On a 5-point scale, the following decision rules were assigned to the students' responses thus: Very great extent, (4.50-5.000); 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).

III. Results

Presented in Table 1 are the results of the research question on the extent to which indoor air pollution in the school workshop as an environmental stressor affect students' effective workshop practice. The indoor pollution stress indicators used were sensitivity to odour, eye irritation (restlessness/inattention), skin irritation (restlessness/inattention), and respiratory/nose irritation (sneezing/coughing).

TABLE 1. Students' mean responses on indoor air pollution as an environmental stressor affecting their effective workshop practice

| Noise stress indicators | Asaba | | Omoku | | Decision | | |
|--|-------|------|-------|------|--------------|------|--------------|
| | XA | SDA | X0 | SD0 | | | |
| Indoor air pollution causes sensitivity to odour (from sawing, forging, spraying and welding activities) which affects time and reaction judgment tasks. | 3.86 | 1.16 | 4.11 | 0.93 | Great extent | | |
| Indoor air pollution causes eye irritation (restlessness/inattention) from spraying, welding, activities which affects reaction time. | 3.94 | 1.23 | 3.93 | 1.05 | Great extent | | |
| Indoor air pollution causes skin irritation (restlessness/inattention) from spraying, welding, forging activities) which affects motor and manual control performance. | 3.66 | 1.08 | 3.63 | 0.97 | Great extent | | |
| Indoor air pollution causes respiratory/nose irritation (sneezing and coughing) which affects skill of manipulation. | 3.50 | 1.22 | 3.94 | 1.14 | Great extent | | |
| Grand mean (XG) | | | 3.74 | 1.17 | 3.90 | 1.02 | Great extent |

From the results, the students' Grand Response Mean (xG) scores of 3.74 and 3.90 for Federal Colleges of Education (Technical), Asaba and their counterparts from Omoku respectively showed that, indoor air pollution as an environmental stressor affected their task performance in workshop practice to a great extent. The Grand Mean Standard Deviations (xG) of 1.17 and 1.02 for the students' responses from Asaba and Omoku scores were small; clustered and close to the mean. This indicated that, the students' mean responses had a small variability and therefore homogeneous.

Thus, it was the opinion of the students that indoor air pollution emanating from dusts, particulates, odour etc during sawing, spraying, forging, welding etc activities which caused sensitivity to odour, eye irritation (restlessness and inattention); skin irritation (restlessness and inattention); and respiratory/nose irritation (sneezing/coughing) affected their task performance in time judgement, reaction judgment, motor/manual control, and skill manipulation in task performance to a great extent. In similar findings, [20, 21] also established that, indoor air pollution stresses impaired time judgement tasks, human reaction time, manual dexterity, and performance decrement in information processing tasks; and that performance results of subjects exposed to indoor air pollution revealed that time judgement and information processing tasks were negatively affected. Inadequate ventilation of workshop space therefore means slow evacuation of gas, fumes, particles and vapour that resulted from workshop activities. And when there is high pollutant content in the workshop space, students will exhibit air pollution related stresses such as sensitivity to odour; and eye, skin and respiratory/nose irritation which in turn affected their task performance.

The results of the hypothesis as presented in Table 2 revealed that there was no significant difference in the mean response scores among students from Federal College of Education (Technical), Asaba and their counterparts from Omoku on the extent to which indoor air pollution in school workshop as an environmental stressor will affect their effective workshop practice.

TABLE 2. Z-test for mean responses of students from Asaba and Omoku on indoor air pollution as an environmental stressor affecting their effective workshop practice

| Colleges | N | X | SD | Df | P ≤ | Z-calculated | Z-critical | Decision |
|----------|----|------|------|-----|------|--------------|------------|------------------|
| Asaba | 70 | 3.74 | 1.17 | 165 | 0.05 | 0.92 | 1.65 | Not significant |
| Omoku | 97 | 3.90 | 1.02 | | | | | Ho: not rejected |

With the Z-calculated of 0.92 less than the Z-table value of 1.65 at $P \leq 0.05$, the null hypothesis that, there was no significant difference in the response scores among students from Federal College of Education (Technical), Asaba and their counterparts from Omoku on the extent to which indoor air pollution in school workshop as an environmental stressor will affect their effective workshop practice was therefore not rejected. The opinion of the two groups of students did not differ significantly on the extent to which indoor air pollution in school workshop as an environmental stressor affected their effective workshop practice because the only source of ventilation in most of the workshops were through the window openings. This was insufficient to remove the indoor air pollution that emanated from welding, sawing, forging etc activities. Further, the pollutants that were not evacuated through the window openings had no other alternative route to escape to the atmosphere as they rose to the internal roof space. There was increased accumulation of indoor air pollutants as more pollutants were introduced into the workshop space when workshop activity was continuous because there was no other ventilation methods such as the continuous ridge type air outlet or several individual round

chimney-type extractors distributed over the roof area was not provided to complement the windows. Therefore, gases, fumes, particles and vapour present in the workshop spaces as a result of welding, sawing, forging and spraying activities were not timely removed. Thus, the workshop space became stuffy and filled with various types of pollutants and the students using such space will exhibit pollution induced stresses; and students' effective workshop practice was also affected.

IV. Conclusion

From the findings of the study, it was the opinion of the students that indoor air pollution in the school workshop as an environmental stressor affected their effective workshop practice. Further, the mean response scores of the students from the Federal College of Education (Technical), Asaba and their counterparts from Omoku did not differ significantly on the extent to which indoor air pollution as an environmental stressor affected their effective workshop practice. It was therefore concluded from the study that, indoor air pollution as an environmental stressor affected students' effective workshop practice at the Federal Colleges of Education (Technical), south-South, Nigeria.

Based on the findings of the study, it was recommended that indoor air pollution in school workshop space should be relatively reduced so that students can carry out task performance effectively during workshop practice. Indoor air pollution in a workshop space can be reduced by providing ventilation ducts of adequate size as effective means of egress of gas fumes, vapour or dust; adequate external windows placed in the direction of the prevailing wind to be complemented with mechanical ventilators on the walls in order to bring the level of pollution within permissible limits.

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