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Analysis of workshop safety and productivity improvement in an engineering workshop

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ABSTRACT

This study carries out an analysis of workshop safety and productivity improvement in an engineering workshop in a University setting. The problem stems from observations made during students' workshop practicals, where concerns regarding fatigue, pain and low productivity were noted. To address these issues, a mixed-methods approach was employed, including surveys, interviews, and observation checklists, to gather data from 367 engineering students. Demographic analysis revealed that a significant proportion of respondents were final year students (58%), with varying levels of workshop usage. Findings also showed that there is a mixed view among students regarding the workshop environment. While a majority perceive the workshop as organised and efficient (58.1% agree), concerns exist regarding cleanliness (only 35.5% agree) and tool accessibility (only 32.3% agree). Safety perceptions reveal that while most students (83.9%) reported never experiencing musculoskeletal injuries, only 48.3% feel confident in the workshop's safety. Furthermore, productivity challenges are evident, with a significant number of students (45.2%) finding it difficult to complete project in the workshop. Based on these findings, recommendations are proposed to address identified concerns, including improvements in workshop organization, maintenance, safety measures,

and productivity enhancements, implementing these recommendations can contribute to creating a safer, more efficient, and student-friendly workshop environment.

Keywords: Workshop Safety, Productivity Improvement, Engineering Students, Engineering Workshop.

INTRODUCTION

Engineering is a key component of innovation and our emerging global technological society (Igbokwe et al., 2019). The context of engineering education is changing, and engineers of the future needs a new set of skill to be able to compete globally (U-Dominic et al., 2017).

To enhance innovation, engineering workshops serve as vital spaces where students gain hands-on experience and practical skills necessary for their future careers. However, these environments can present challenges related to ergonomic design and workplace practices, affecting student comfort, safety, and productivity. Understanding and addressing these challenges are essential to ensuring a positive and effective learning experience for students.

An effective safety practice in an engineering workshop involves all parties involved, both inside and outside the workshop, and strives for continuous improvement in health, environment, and safety performance (Farounbi et al., 2018). Given that engineering workshops are designed to instruct students who need to acquire prior knowledge of these machines' functions, incidents are more likely to happen (Ordu et al., 2022; Vengidason et al., 2021).

Thus a key element in achieving complete safety in the workshop is the proper assessment of the numerous risks involved in the job specifications, as well as the right execution and adherence to the necessary safety standards by instructors and other workshop users (Adejuyigbe et al., 2013).

Despite improvements in accident avoidance strategies and the provision of a secure and healthy work environment for students, there is still a need for a comprehensive approach to engineering workshop safety (Farounbi et al., 2018). Thus this study carries out an analysis of workshop safety and productivity improvement in an engineering workshop in a University Setting.

METHODOLOGY

Data was collected using Questionnaires with Closed-ended Questions. The questionnaire was created to gather quantitative data that captures engineering students' perspectives on workshop safety and productivity. This involves structured, closed-ended questions with predefined response options. In-depth interview questions were drafted to complement the quantitative data, providing richer insights into participants' experiences and perceptions. A sample size of 357 students was selected based on their knowledge of workshop safety and the engineering workshop. Minitab 22 software was used to conduct Exploratory Data Analysis on the data from the survey.

Participants were informed about the purpose of the research, and measures were taken to protect participant's confidentiality, particularly in qualitative components.

RESULTS AND DISCUSSION

Out of 367 Engineering students that responded, 213 students were final year students, 118 third year students, 24 year four students and 12 second year students. A significant number

of the respondents were from Industrial and Production Engineering Department, while others were from other departments as shown in table 1.

It also showed that the majority of students, about 54.8%, visit the workshop occasionally. 19.4% of the students rarely visit the workshop, maybe only during practical workshops. Whereas 22.6% of them visit the workshop most times.

Table 1

Demographic Results Based on Departments and Workshop Usage

Year	No of Respondents	%
Second year	12	3.2
Third year	118	32.3
Fourth year	24	6.5
Finals	213	58
Total	367	100
Engineering Discipline		
Chemical Engineering	24	6.5
Electrical Engineering	12	3.2
Industrial and Production Engineering	296	80.6
Material and Metallurgical Engineering	24	6.5
Mechanical Engineering	11	3.2
Total	367	100
Workshop Usage		
Always	12	3.2
Most times	83	22.6
Occasionally	201	54.8
Rarely	71	19.4
Never	0	0
Total	367	100

As illustrated in table 2, 118 students agreed that the workshop is organized and efficient while 95 students feel that the workshop is not really efficient and organized. 130 students feel that the workshop is clean and well maintained while 107 students feel otherwise. Also, 119 students agreed that the tools are accessible and in good working condition while 108 students felt otherwise. Then concerning lighting and ventilation, 107 students agreed that it is adequate while 69 students were against the fact that the lighting and ventilation in the workshop is adequate. This shows that a majority of the students perceive that the ergonomic condition of the workshop is good, although there is a notable proportion who thinks otherwise.

Table 2

Respondents Test Results Based on Their Perception of Ergonomics in The Workshop

Workshop Environment	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
The workshop layout is organized and efficient	24 6.5%	94 25.8%	154 41.9%	71 19.4%	24 6.5%
The workspace is clean and well-maintained	35 9.7%	95 25.8%	130 35.5%	71 19.4%	36 9.7%
The equipment is accessible or available and in good working condition.	24 6.5%	95 25.8%	130 35.5%	83 22.6%	35 9.7%

There is adequate lighting and ventilation in the workshop	24 6.5%	83 22.6%	201 54.8%	35 9.7%	24 6.5%
The noise level in the workshop is acceptable	24 6.5%	106 29%	201 54.8%	24 6.5%	12 3.2%

In table 3, 308 respondents reported that have never experienced musculoskeletal injuries in the past, indicating that 83.9% of participants have not experienced musculoskeletal injuries. Conversely, 59 respondents indicated that they have not experienced musculoskeletal injuries, representing about 16.1% of the surveyed population.

Also, 178 students (48.3%) are confident that the workshop is a safe working environment while 59 students (16.1%) of the respondents think otherwise.

Table 3

Respondents Test Results Based on Their Perception of Workshop Safety

	Strongly Agree	Agree	Neutral	Disagree	Strongly disagree
Have you ever experienced any incidents, musculoskeletal disorders or injuries while using the workshop?	59 16.1			No 308 83.9	
How confident are you that the workshop is a safe working environment?	47 12.9	131 35.5	130 35.5	59 16.1	0 0
Do you feel you have received adequate safety training for using the workshop equipment?	90.3			9.7	

It was observed that conducting practical experiments in the workshop can be very stressful and tiring, as more of manual work is done, especially in the cutting process instead of using machines that would make the work easier. As a result taking a longer time, than the scheduled time allocated. Poor ventilation and lighting systems available plays a huge role in ensuring that, the workshop experience is not a pleasant one.

There is just one exit in the workshop, the other one is not really accessible in case of emergency. Students are not given complete protective clothing and equipment for workshop practice. Some complained that working for a long time with their palms cause blisters and sometimes cuts.

Issue of power supply is the major reason delaying workshop practical. There is strict dependence on the normal power supply and there is no alternative in case power goes off.

In summary, this study investigated the workshop environment and its impact on safety, productivity and student experiences. Results concluded from this research shows that there is a pressing need for the workshop to undergo reorganization and structural changes. The observed lack of organization and maintenance in the workshop, as evidenced by scattered tools and equipment, litters on the floor, and suboptimal working conditions explains the urgency of addressing these issues. Without proper organization and maintenance protocols in place, the workshop environment poses significant safety hazards and impedes student productivity.

Reorganising the workshop layout and implementing systematic storage solutions for tools and equipment would not only improve workflow efficiency but also enhance safety by reducing the risks of accident and injuries.

CONCLUSION

These findings highlight a mixed perception of the workshop environment, with strengths in organization and accessibility but challenges in cleanliness, safety, and productivity. Students expressed frustration with the manual labour-intensive nature of workshop tasks and the lack of sufficient tools and equipment.

Issues such as poor ventilation, inadequate lighting, and limited seating contribute to discomfort and fatigue among students. Safety hazards, including inadequate emergency exits, incomplete and damaged personal protective equipment, pose risks to student well-being.

Implementing a systematic tool organization system will greatly improve efficiency and accessibility in the workshop while allocating a dedicated space for each tool and equipment category to minimize clutter and facilitate easy retrieval. Conducting regular safety audits and inspections will help identify and address potential hazards. This will ensure adequate comprehensive safety training for students and staff, emphasizing proper tool usage, personal protective equipment (PPE), and emergency procedures. By implementing the recommended changes, workshop administrators can improve safety, productivity, and overall student experiences in the workshop, addressing the identified challenges in the workshop environment, safety, and productivity is essential for creating a safer, more efficient and conducive workspace for students.

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