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Determinants of students' selection of protective clothing in technical institutions in Central Kenya

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Abstract
The research sought to investigate selection, use and maintenance of protective clothing in Technical Institutions in Central Kenya. Based on the study, this paper examines the factors influencing selection of protective clothing by students. The study area was purposively selected as it had majority of the technical institutions. Stratified sampling was used to select three technical institutions which participated in the study. Qualitative data was collected using a questionnaire which was administered by the researcher to a sample of 119 respondents in the participating departments. Majority of the respondents (88.2%) indicated that colour was important when selecting protective clothing. Harmful materials handled by respondents and price were also important when selecting protective clothing. Pearson's correlation coefficient was used to determine the relationships between selected key variables. The study concluded that protective clothing is not fully used by students in Technical Institutions in Central Kenya. Technical Institutions in Central Kenya need to enlighten their students on care of textile articles and use in terms of selection, use and maintenance of protective clothing. The study indicated that the training students had received on protective clothing did not play a significant role towards selection of protective clothing. The study recommended that the students in technical institutions in Central Kenya should be trained on the use of protective clothing by their course instructors on reporting to the institutions.

Keywords: Students, Selection, Protective Clothing, Technical Institutions, Central Kenya

1. Introduction
Protective clothing is used to reduce or minimize the exposure or contact to injurious physical, chemical or biological agents. The workshops/laboratories contain environmental, chemical, biological and physical risks which with proper control can be eliminated or minimized. It is impossible to completely eliminate hazards using protective clothing, but the risks of injury are greatly reduced (University of St. Andrews, 2008) [13]. Therefore, wearing protective clothing is the recommended standard in all situations where people are potentially exposed to hazards. Some of the protective clothing used in different workshops and laboratories are as shown in Table 1.

Table 1: Protective Clothing used in Different Workshops and Laboratories

Departments	Protective clothing
Electrical engineering workshop	Eye goggles, face mask, face shield, leather gloves, hard foot wear, leggings, helmet, navy blue dustcoat, knee caps, ear muffs and nose muffs.
Applied science laboratories	Nose muffs, gumboots, white dust coat, latex or rubber gloves, face mask, gas mask with respirator.
Clothing Technology workshop	Aprons, gloves, face and nose muffs, closed shoes, Dust coats

Source: Scotland, University of St. Andrews (2008) [13]; Trevor (2008) [11]

Selection of Protective Clothing
Once the need for protective clothing has been established, the next task is to select the proper type of protective clothing putting into consideration user suitability, the degree of protection required and the appropriateness of the equipment to the situation (University of St. Andrews, 2008) [13]. The degree of protection and design of protective clothing must be integrated because both affect its overall efficiency, wearability and acceptance (Trevor, 2008) [11]. Therefore, a checklist on issues to be considered in the selection of protective clothing should be used (Table 2) (University of Wollongong, 2009) [15]. There are so many types of protective clothing that make appropriate selection difficult. Four factors that require consideration when selecting appropriate protective clothing include: Chemical, biological, physical and environmental (University of St. Andrews, 2008) [13].

Table 2: Checklist on Issues to be considered in the Selection of Protective Clothing

S. No.	Type of protective clothing	Issues
1	Respirator	• Is the environment regularly monitored for hazardous substances? • Are there other control measures in place to contain the hazard? • Is respirator fit conducted? • Respirator limitations considered • Training in the use, storage and maintenance of the respirators

2	Eye protection	• Does it offer adequate protection against the hazard? • Does it distort the vision of the user? • Does it limit peripheral vision? • Are there gaps between the side shields and face which might allow particles to enter?
3	Face protection	• Does it offer adequate protection against the hazard? • Is eye protection also needed? • Does it distort the vision of the user? • Does it limit peripheral vision? • Are there gaps between the side shields and face which might allow particles to enter?
4	Head protection	• Does it offer protection against the hazard? • Are liners, chin straps and sweatbands used to keep it in place? • Will it fit properly? • Does it affect movement of the head? • Will it be too bulky?
5	Hearing protection	• Does it offer adequate protection against noise? • Are they comfortable to wear? • Are they comfortable to wear? • Are ear muffs adjustable? • Any associated medical conditions with wearing ear protectors? • Does it create pressure to the chin, head or behind the ears? • Are there any other systems in place to alert wearer of any emergencies?
6	Hand protection	• Is it of adequate length to protect against the hazard? • Is it to the correct size? • Does if offer adequate protection or is it suitable to be used against the hazard? • Will it restrict hand movement or interfere with the task? • Is it too slippery or too bulky?
7	Leg and foot protection	• Does it offer adequate protection against the hazard? • Is it too bulky? • Is it comfortable to wear?
8	Body protection	• Is the clothing of the right size? • Does it offer adequate protection against the hazard? • Is it comfortable to wear?
9	Fall protection	• Is the harness suitable for the task at hand? • Does it fit the user? • Will it interfere with the task?

Source: University of St. Andrews (2008); University of Wollongong (2009) [15]

When it comes to choosing the appropriate type of protective clothing, the functional role should be emphasized (Trevor, 2008) [11]. Ideally, the practical function of clothing is to protect the human body from dangers in the environment. Crane (2001) [2] identifies such environmental dangers as weather (strong sunlight, extreme heat or cold and precipitation), insects, noxious chemicals, weapons and contact with abrasive substances and other hazards.

For maximum protection, appropriate protective clothing should be chosen (University of St. Andrews, 2008) [13]. For one to choose the appropriate protective clothing, the purpose for which the protective clothing is being chosen should be first understood (Crane, 2001) [2]. For example, a laboratory coat is meant to protect the wearer against minor splashes or spills, as well as keeping the ordinary clothing away from contamination by the materials used in the laboratory. For very cold conditions, thermally insulated clothing like coats, vests, underwear and aprons must be worn (Torres, 2007) [10].

Laboratory coat fabrics need to be suitable for the work environment, the objects that are being handled and the task at hand. The most appropriate fabric used in the making of laboratory coats is cotton or cotton/polyester (Beryl, 1976). In addition, clothing needs to fit properly, when worn and provide appropriate flexibility to carry out tasks (Tselepis & De Klerk, 2004) [12]. Due to the fact that laboratory coats offer limited protection, other appropriate clothing like aprons, leggings, masks, sleeve protectors and overalls are required to be worn so as to achieve the required standard of protection (University of Toronto, 1999; University of St. Andrews, 2008) [14, 13].

There are varieties of protective clothing which can be used for high temperature exposure. The choice of the protective clothing may include apparel made of leather, aluminized fabric, or other heat resistant materials, depending on the source of heat (The Regents of the University of California, 2006) [9]. Activities that involve the generation of heat are also accompanied by the generation of loose particles and sparks. It is, therefore, necessary to protect the eyes from excess light and the face from flying particles. Cutting and welding activities are some of the common activities that take place in Technical Institution in Central Kenya workshops, where hazards are likely to occur.

In industrial and military settings, where workers are exposed to potentially hazardous solvents, materials and chemical agents, there is need for workers to wear chemical protective clothing (CPC). The components of a CPC are a gas mask

with a respirator; a protective hood that covers the head and shoulders; a suit (trousers and overcoat, or overalls); industrial protective gloves; and rubber over boots. A CPC collection can be worn in various configurations, depending on the required level of protection. Both the military and commercial sectors provide guidelines meant to obtain the appropriate level of protection. Krueger and Banderet (1997) [8] note that maximum protection can be achieved when all components of the CPC are worn.

According to information published by the Bureau of Labour and Statistics (BLS) in 2005, it is revealed that 1.2 million American workers were injured on the job, 34,740 being eye injuries, and required recuperation away from work (Torres, 2007) [10]. These injuries can be drastically reduced if there is proper face and eye protection. This is clearly indicated by a report by Prevent Blindness America, where it is recognized that more than 86,000 workers, who were involved in potentially serious incidents, managed to save their sight by wearing proper eye and face protective gear (Torres, 2007) [10].

In a research conducted in Technical Institutions by the GoK (2008), it was revealed that there is no provision related to PPEs for workers (GoK, 2008). The research also identifies a lack of a sound procedure for the maintenance of PPEs, lack of maintenance team and lack of signage that would prompt the use of protective gears in certain areas. Trevor (2008) [11] notes that after training it is the user's sole responsibility to select appropriate combinations of chemical protective suits and ancillaries for his particular application. The user needs to evaluate the performance of protective equipment such as durability, comfort, quantity, compatibility with other personal protective equipment and environmental compatibility. The study aimed at establishing the factors surrounding the selection, use and maintenance of protective clothing in Technical Institutions in Central Kenya. The study also sought to ascertain students' know-how on protective clothing in terms of selection, use and maintenance.

Problem Statement

The selection, use and maintenance of protective clothing are very important in all situations where a person is potentially exposed to hazards. The area of protective clothing is less researched in Kenya. In technical institutions there many activities take place, most of which may require the use of protective clothing by students and staff. Most of the courses that are offered in the technical institutions involve practical lessons, which should be performed at the laboratory or workshops. Anyone involved in practical lessons is subsequently exposed to different hazards.

In Kenya, the need to use protective clothing has been stipulated in *The Occupational Safety and Health Act* of 2007. It is clearly stipulated in the Act that every employer is supposed to provide and maintain suitable protective clothing for employees, where they are exposed to wet or any injurious or offensive substance. The Act further gives the Director of Occupational Safety and Health Services the mandate to register safety consultants to assess the suitability and effectiveness of protective clothing and appliances (GoK, 2007a) [4]. The GoK (2007a) [4] further indicates a lack of an effective personal protective clothing replacement programme in place and lack of knowledge on selection and utilization of the same by employees. Students sometimes do not have the appropriate protective clothing during their practical lessons and other times do not have at all. There was need for a study of the factors that surround the use of personal protective clothing by students in the technical institutions.

Therefore, appropriate protective clothing is necessary in laboratories, where chemical, biological or other hazardous materials are used and stored. In most laboratory conditions, hazards can be rated as being mild to moderate in nature. In such circumstances, protective clothing must be worn when working in the laboratory. The study focused on selection, use and maintenance of protective clothing by students in Technical Institutions in central Kenya.

2. Materials and Methods

The study area was conducted in Nyeri, Murang'a and Kirinyaga Counties in Central Kenya. The location of the study area makes the technical institutions in Central Kenya more accessible to students and staff from different parts of the country. The area was also chosen because it was easily accessible to the researcher. Descriptive survey was used in the study. The method was preferred because information would be readily obtainable from respondents in the workshops and laboratories, concerning their attitudes on selection, use and maintenance of protective clothing.

The target population of the research comprised students of technical institutions in Murang'a, Nyeri and Kirinyaga Counties in Central Kenya, who belonged to the following departments: clothing technology, electrical engineering, and applied sciences. These departments were chosen because most of their courses are more practical oriented than theoretical. The nature of work in the mentioned departments also pose the highest percentage of accidents, since the students are directly in contact with live wires, solid and liquid chemicals, contagious gases, harmful dust-like cloth dust, loud noise and harmful temperature extremes.

The sampling units for the study consisted of technical institutions in Nyeri, Murang'a and Kirinyaga Counties in Central Kenya. Purposive sampling method was used to identify the technical training institutes (TTIs) and institutes of science and technology (ISTs). These were Murang'a College of Technology, Kirinyaga Technical Institute and Nyeri Technical Institute. The study targeted all the second-year students undertaking a three-year diploma course in Clothing Technology, Electrical Engineering or Applied Science Departments. These groups of respondents were targeted because they had been in the institutions for a considerable length of time and this meant they had more information than the first-years who had just joined the institutions. While the third-year students might have had more information they were busy with their projects and preparation for their final exams. This hindered them from participating in the study.

All the second-year diploma students in the three institutions and belonging to the three departments were requested to participate in the study, by filling in a questionnaire. There were 20 respondents from Clothing Technology department, 57 from Electrical Engineering department and 42 from Applied Sciences department. Therefore, from the three institutions, each with three departments, the total number of respondents who participated in the study was 119.

The data collection tool used in the study was a questionnaire. The collected data was analysed using descriptive statistical

method with the aid of the Statistical Package for Social Sciences (SPSS), version 17.0. Pearson correlation coefficient was used to examine the relationship, the strength and direction of association between the study variables. The analyzed data was summarized by percentages and presented using tables, bar graphs and pie charts.

3. Results and Discussion

Factors that Influence the Selection of Protective Clothing in Technical Institution

The study sought to examine the factors that influence the selection of protective clothing by students in technical training institutions in central Kenya. The factors that were identified were:

1. Colour
2. Price of protective clothing
3. Knowledge
4. Other factors

Importance of Colour

The respondents were asked to state if colour in protective clothing selection was important. Their responses were as shown in the table below.

Table 3: Importance of Colour

Response	Frequency	Percent
Yes	105	88.2
No	14	11.8
Total	119	100.0

Majority of the respondents (88.24%) indicated that colour was important when selecting protective clothing while 11.8% did not consider colour as an important factor. The respondents' explanation for the colour significance was that it simply differentiated each department from the others, as directed by the management of the institution. Some of the respondents indicated that dull colours like black and navy blue were preferred for overalls and lab coats in Electrical Engineering department workshops. This was due to the nature of work and dust in the workshops.

The preferred colour for lab coats in Applied Science department was white as directed by the management. The white colour is important as stains are easily seen when a chemical spills on a lab coat. This helps in easy identification of stains during the cleaning process and it also encourages the students to be keen during their practical lessons, as they strive to maintain the lab coat stainless. However, none of the respondents indicated that there was need for choosing protective clothing with colour fastness.

Price of Protective Clothing

Price was another factor that was highlighted by the respondents as important when selecting protective clothing. When the respondents were asked if the price of the protective clothing was affordable, the results were as shown in Figure 1.

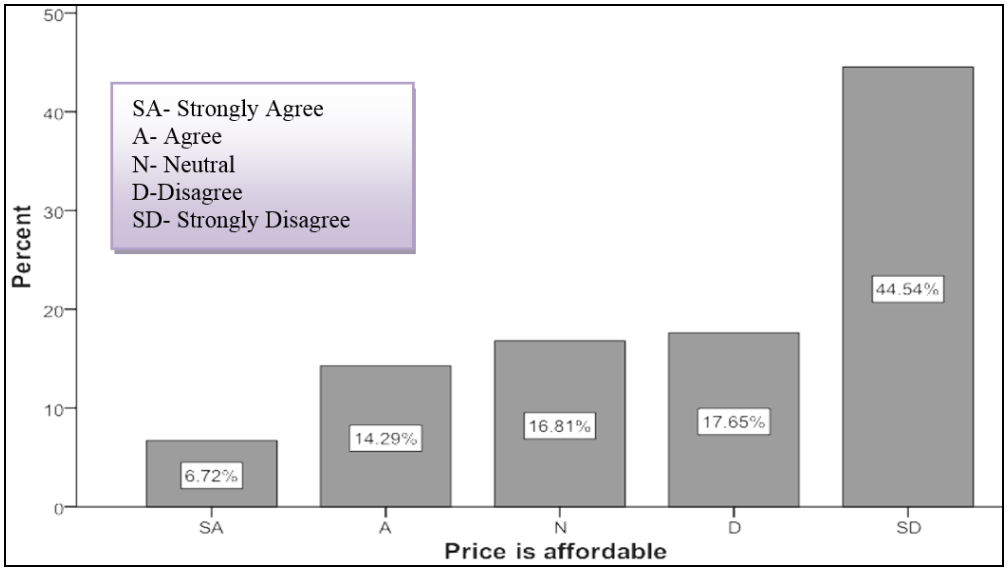

Fig 1: Affordability of protective clothing

From the results in Figure 1, it can be seen that majority of the respondents indicated that the price of protective clothing was unaffordable, but 44.54% of the respondents strongly disagreed with the statement on affordability. In this case the administration in technical institutions needs to introduce cost sharing on protective clothing as they provide them to the respondents. This would eliminate the issue of unaffordability of protective clothing. However, there is need for the respondents to understand that when considering price in choosing protective clothing, lower priced clothing can only be chosen if it serves the intended purpose.

Correlation between Respondents' Knowledge and Selection of Protective Clothing

The table below shows the results for a correlation between protective clothing use and difficulty in selection.

Table 4: Correlation between Respondents' Knowledge and Selection of Protective Clothing

		Protective clothing use understanding
Protective clothing use understanding	Pearson Correlation	1
Difficulty in selection	Pearson Correlation	-.033

The variable used in measuring knowledge of the respondents about protective clothing was: "I do not understand why most of the protective clothing should be worn during practical lessons". The respondents who agreed with this statement indicated that they had limited information on use of protective clothing. On the other hand, the statement "wearing protective clothing makes it much more difficult to perform tasks" was used to measure appropriateness in the selection of protective clothing. As indicated in Table 4, respondents agreed with the statement meaning that there was difficulty in selection of appropriate protective clothing. Therefore, there is no significant correlation between the two variables.

Other Factors Influencing Selection

In the Applied Science department, the respondents were concerned about the harmful materials that they handled during their practical lessons and thus, they preferred to use protective clothing such as gloves, facemasks, gumboots and dust coats. The gloves used in Applied Science are designed to avoid the chemicals and other infectious materials from getting in contact with the body. The gloves used in Applied Science Department are latex or rubber material (Juergens, 2004). The disposable gloves and facemasks were provided to the respondents during practical lessons where the administration felt it was necessary as a way of controlling safety. In the Applied Science department 30 out of the 42 respondents had lab coats while 12 of the respondents did not have any protective clothing. In the Clothing Technology department 16 out of the 20 respondents had aprons. In the department disposable gloves and face masks were provided by the management while carrying out the practical lessons.

According to University of California (2006) [9], Electrical Engineering departments should use fireproof overalls which depend on the source of heat and material used on protective clothing to avoid injuries in the workshops. The figure below shows protective clothing used in Electrical Engineering department.

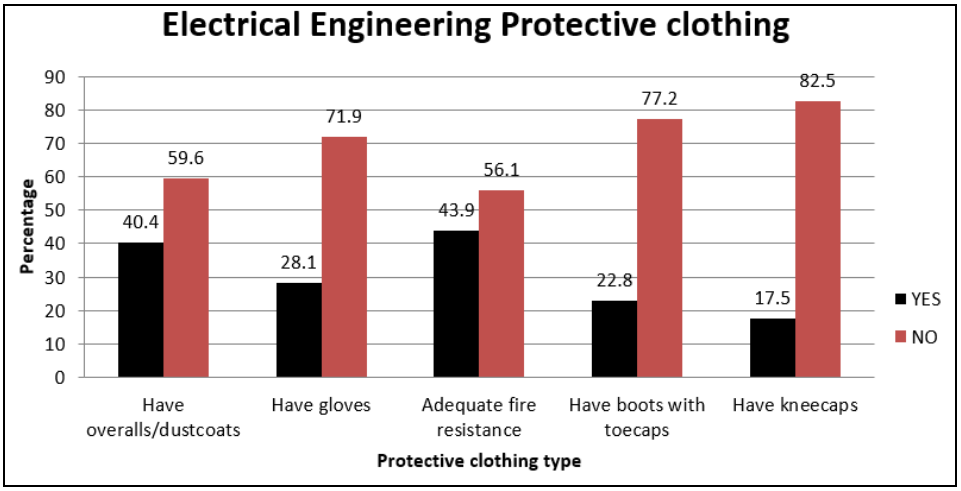

Fig 2: Protective clothing use in Electrical Engineering department

As indicated in Figure 2, 59.6% of the respondents indicated that they did not have an overall or a dust coat which they could have worn during the practical lesson. The fabric used on protective clothing need to be resistant to wear due to the rough conditions they are exposed to in the workshops. When the respondents were asked if the overalls and dust coats used in the department has adequate resistance to fire 56.9% disagreed. This could have been due to lack of knowledge on fire resistance protective clothing.

Boots with toecaps are required by students in Electrical Engineering department workshops as this protects the wearer from heavy and sharp objects that may fall on the feet accidentally from the benches. From the results in Figure 2, it can be seen that 77.2% of the respondents from the Electrical Engineering department did not have boots with toecaps. This is an indication that the management needs to introduce cost sharing as they include the charges in the respondents' school fees. This will make the respondents use protective clothing as a safety control measure in the workshop.

The gloves used in Electrical Engineering need to protect the wearer from physical injury on their hands. The gloves material selected thus should be able to cushion the hands against high temperatures on items being handled and the rough surfaces. Juergens (2004) posits that materials that can fulfil this purpose are leather, canvas or padded materials. The respondents also indicated that the gloves need to protect them against electrical shocks. The Electrical Engineering respondents also pointed out that kneecaps were important as they protect knees during their practical lessons when kneeling during certain operations.

From Figure 2 it is observed that 71.9% of the respondents from Electrical Engineering department lacked gloves while 82.5% respondents from the same department lacked kneecaps. This is an indication that there was no adherence to full protective wear by the respondents while in the workshops. The lab coats and the overalls are selected bearing in mind the need to protect the civilian clothing underneath from getting in contact with substances like oils chemicals and fire particles. As guided by the conceptual framework, the respondents did not consider the environmental factors or the user suitability. This leaves a gap where the respondents need more information on protective clothing selection (University of St. Andrews, 2008).

The size of protective clothing was pointed out by the respondents as an important selection criterion. The respondents identified the need for all the protective clothing

being well-fitting. University of Toronto (1999) [14] asserts that all protective clothing requires to be well fitting when worn so as to achieve the required standard of protection (University of Toronto, 1999) [14]. It was observed that many respondents had protective clothing which were not well-fitting especially the lab coats.

4. Conclusion and Recommendations

The results of the study presented in this paper show that colour, knowledge, price, fabric and design of protective clothing are significantly important to students in technical institutions in Central Kenya when selecting protective clothing. On the other hand, the training that the students in technical institutions in Central Kenya had received on protective clothing has not played a significant role towards adoption of safety measures. It is, therefore, recommended that laboratory and workshop rules should be made available, magnified and displayed for students in technical institutions in Central Kenya.

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