The importance of safety learning to increase student awareness when working in laboratories in vocational education institutions

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Abstract. Laboratory is the most important instrument in vocational education. That is a place where student working in vocational education institution. Therefore, big attention for safety aspect becomes the priority. Students practiced under the risk. Thus, they needs safety and healthy in working environment, especially in laboratory. The identification of potential hazards and risks must be done in Laboratory. This study have assessed 5 of potential hazards and risks in Politeknik Negeri Medan laboratory by Likert Scale. This object was divided into 2 assessment, namely likelihood of hazards and severity of consequences. The data are collected based on questionnaire results that involving 100 students with random academic level. The result shows that the highest state is chemical hazards, which accounted for 73.2% in likelihood of hazards, meanwhile electrical hazards contributed of 85% in severity of consequences. These condition are classified as “high” state. The specific attention must be given to “high” state. The action plan table giving an information literacy to help us for determining mitigate action.

1. Introduction
Vocational Education (VE) is one of education which is tended to skill development. VE produces individual who have competency and professional to human resources needs in industry. The important instrument in VE is laboratory. In the past, accidents and diseases are an evitable part in laboratory. Thousands of students practice under the risk. It needs to be done safety at practice environment step by step because it is related to human soul and social cost are very expensive. Now, Ministry of Research and Technology for Higher Education (MORTHE) has regional standard about safety in laboratory. Safety concept will be effective and efficient if we know information about safety laboratory. It can help us to make decisions and determine the success or failures of the laboratory activities. According to this fact, the urgency of learning safety first must be done in our laboratory. This study aims to foster safety culture in student’s self. Finally, it can be applied in industry after students graduated.

2. Literature Review

2.1. Vocational Education
Business and industry need employees who have work skills for each level. This is a new paradigm towards demand changes of employee. Vocational education institutions as employee provider must pay attention and follow up this transformation. This is important to do in order to link and match between industry and campus [3]. Vocational education concept should be able to produce employability skills about digital literacy and communication [1]. Information literacy and communication skills become responsibility of...
vocational education institutions. Safety is the most important thing and urgent to be informed and communicated for whole academics at vocational education institutions.

2.2 Risk Management
Comply with regulation is able to prevent incidents, injuries, ill health, property damage, environmental impact at laboratory. Risk management is needed to make regulation. Firstly, hazards identification. All possible harm factors must be inspected, audit and reported. Next, the overall are estimated by risk assessment to know how far dangerous level and deciding what actions will be taken.
After all processes have been carried out, so that to do control risk. The steps are risk elimination, risk substitution, engineering, administrative and using personal protective equipment (PPE). Finally, all activities related to risk management must be reviewed and improved as well.

![Figure 1. Risk Management Diagram](image)

2.3 Likert Scale
Likert scale is so popular for measurement to collect data about the emotional intelligence competencies early. Likert has a capacity to measure the attitude of the respondents easily. Moreover, it is easy to make statements to capture the essence of a specific construction. It is also easy to understand and respondents feel easy to provide their perception through Likert type format [2][4][7]. This study uses five point scale of likelihood and five point scale of severity of consequences. State of five point scale can be used to assess identification of potential hazards in laboratory. Related questions are written on paper questionnaires and completed the five point scale.

3. Method
Method stages have been summarized into 4 major stages that following:

3.1 Preliminary Observation
The first stage is analyzing of potential hazards and collecting data in the laboratory. This is preliminary observation that involved the students and answering questionnaire to obtain information about hazards and impacted towards learning process. There are 5 identifications of potential hazards in Telecommunication laboratory. They are consists of:

- Chemical Hazards
- Electrical Hazards
• Ergonomic Hazards
• Fire Hazards
• Physical Hazards

3.2. **Document Control**

The second stage is designing the document control. Document control contains some questions related to kind of hazards. Document control is answered by existing conditions and objectives. Instructional questions are referring to the syllabuses which expect to support teaching and learning activities and practice. The result of document control is necessary to assess the risk of hazards.

3.3. **Classified of Risk Assessment**

The third stage, hazards are classified into 2 assessment namely likelihood of hazard and severity of consequences. The function of Likert scale is estimate the level of potential risk.

3.4. **Corrective Action**

The fourth stage is determine corrective action and action plan. Corrective action is made according to risk assessment. It should be considered as mitigate action, doing inspection about impact, form and process of potential hazards. Next, deciding action plan as recommended action to mitigate potential hazards.

4. **Result and Discussion**

Collecting data is done in 5 questionnaire forms. The questions are divided into 5 parts of assessment of identification hazards. Each questionnaire is given to students at Electrical Department of Politeknik Negeri Medan. Furthermore, the numbers of 100 students are involved in this research from random academic level.

4.1. **Result of Response**

The Result of response are divided into 2 criterias. They are likelihood of hazards and severity of consequences. Likert scale is used to estimate the level of index potential risk. Chemical hazard contributed of 73.2% in response of likelihood of hazards, whereas electrical hazard is accounted for 85% in response of severity of consequences [6]. They were the highest state of hazard.

4.2. **Corrective Action**

Corrective action was made by according to risk assessment. Seriously attention must be done for potential hazard that have high index. It should be considered as mitigate action. Here they are:

Corrective Action for Chemical Hazards:

• All chemical materials should be considered as a potential danger resources. An enormous attention must be given to impact of these chemicals.
• Knowing the form of chemicals along working process. It can help us to determine how it can contact or enter into our body and how it can be controlled.
• Install disposal equipment at source of pollutants.
• Personal Protective Equipment (PPE) using is required to protect body such as respirator, gloves and many more.
• Labeling in the chemical materials. Labeling can be formed as images, symbols, letters, articles, or combination both of them or any other statements that they are hazardous materials.

Corrective Action for Physical Hazards:
• Conduct to inspect toward sources of noise at workplace. The inspections must be done at different time to ensure that all sources of noise are identified.
• People use Personal Protective Equipment (PPE) such as earplug at location which noise level cannot be reduced.
• People get appropriate lighting level at workplace for sure. They should not work in bent position or squinting eyes.
• Get Control vibration by installation of vibration absorber or shock absorber.
• If the vibration is caused by the big machine, install vibration absorber on floor to cover the workplace. People may use PPE such as footwear and gloves to absorb the vibration.

Corrective Action for Ergonomic Hazards:

• Providing a good workplace or seat appropriate including backrest, comfortable seat and good furniture.
• Tools placement must be easy to reach, so that shoulder position in neutral, relax and arms straight forward when it working.
• Make consider to job rotation and give adequate break after working intensive.

Corrective Action for Electrical hazards:

• The electrical hazards are controlled by direct touch. For instance, isolating the active polar, closed by barrier or enclosure, create hurdles to give safe distance or out of range and use Personal Protective Equipment (PPE).
• The electrical hazards are controlled by indirect touch. For example, installing the grounding of electrical equipment. It should be use 3 wiring cables. When current shock or lightning voltage, current flows to the ground. At the same time, grounding is going to far the tools resistance.

Corrective Action for Fire Hazards:

• Provision of detection alarm, fire extinguisher and evacuation facilities.
• Establishment of fire prevention unit in workplace and contain training in fire prevention periodically.

4.3. Action Plan
The action plan is contain whole content about potential hazard and recommended action to mitigate, as following:

| Potential Hazards | Ferric Chloride | Chemical Storage | Etching Process |
|-------------------|----------------|------------------|-----------------|
| Impacted          | Heat, corrosive| Spilled problem, burned | Heat, corrosive, spilled problem |

Table 1. Action Plan for Chemical Hazards
Table 2. Action Plan for Physical Hazards

| Potential Hazards | Impacted | Hazards in Process | Recommended Action |
|-------------------|----------|--------------------|--------------------|
| Noise             | Listening disaster | Listening | Use PPE such as earplug. |
| Full vibration room | Listening, impotence | Working in vibration area | a. Use PPE such as earplug, footwear, gloves. |
| Inadequate Lighting | Vision disaster | Working in inadequate lighting area | b. Install vibration absorber |

Table 3. Action Plan for Ergonomic Hazards

| Potential Hazards | Impacted | Hazards in Process | Recommended Action |
|-------------------|----------|--------------------|--------------------|
| Uncomfortable chair | Not relax, disturbance at backbone | While seating and working | Provide good workplace or seating appropriate including backrest, comfortable seat and good furniture. |
| Crowded Tools | Lost time in working | While seating and working | Tools placement must be easy to reach. |
| Monotonous Condition | Performance reduction | Boring, bad mood | Making job rotation and give adequate break after working intensive. |
Table 4. Action Plan for Electrical Hazards

| Potential Hazards | Impacted | Hazards in Process | Recommended Action |
|-------------------|----------|--------------------|--------------------|
| Exfoliate Isolation | Electrical shock, spark fire | Direct touch | a. Isolate the active polar, closed by barrier or enclosure.  
  b. Use Personal Protective Equipment (PPE) such as rubber glove, rubber foot ware. |
| No Grounding | Electrical shock, overload equipment | Indirect touch | Install grounding system in electrical equipment, electrical equipment should be using 3 wiring cables. |
| Bad Wiring Installation | Electrical shock, short circuit, overload | Direct touch and indirect touch | a. Provide save wiring installation.  
  b. Use isolation pipe to cover the wire. |

Table 5. Action Plan for Fire Hazards

| Potential Hazards | Impacted | Hazards in Process | Recommended Action |
|-------------------|----------|--------------------|--------------------|
| Flammable Material | Wildfire | Cigarette ignited | Keep in safe place |
| Bad Evacuation Route | Disturb evacuation processing | People can not save themselves | Improve the layout of building |
| Fire extinguisher in bad position | Difficult to extinguish the fire | Crowed in wildfire | Provision of detection alarm, fire extinguisher and evacuation facilities. |
5. Conclusion
Those risk should be considered as a potential danger resources. It should be given a big attention about the impact of risks in high state. It can help us to determine mitigate action. For instance, how chemical spilled can contact or enter into our body and how it can be controlled. Personal Protective Equipment (PPE) is required to protect body such as respirator, gloves, dustcoat and many more. In other side, electrical hazards can be dissociated by direct touch. Isolate the active polar, closed by barrier or enclosure, create hurdles to give safe distance or out of range. Inspections must be done at all the time to ensure that all potential risk is identified. Sustainable action gives us more advantages to maintain potential hazards that may be arise at anytime.

The Implementation of identify potential hazards, risk assessment and risk management must be monitored constantly to ensure that policies are obeyed. Many things that should not be ignored in order to follow up risk management, they are: Individual variation characteristic, Number of practicum in laboratory, Frequency of practice, Level of risk and possibility to achieve a safe level and financial aspects of risk.

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