Investigation on Safety Anthropic Factor of Labs and Undergraduate Education in the University

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Abstract. Frequent lab accidents have drawn public attention. Anthropic factor is the main reason of lab accidents. Through the questionnaire, the awareness of lab safety knowledge and the familiarity of with lab safety behaviors of students who participate in experiments can be known, moreover the effects of the amount of lab experience and the diversity of education levels on investigation results are analyzed. The results indicate that: postgraduates have higher education levels; both postgraduates and undergraduates are lack of systematic understanding to the disposals of lab routine accidents. Safety behaviors of students who have less lab experience are more normative and rigorous, therefore, the education of emergency treatment of accident and the training for students who have less lab experience should be strengthened in safety education.

Introduction

Lab safety is related to the normal teaching of the school and the smooth development of scientific research, which is very important for the safety and stability of the school and society [1-4]. In recent years, major lab accidents have occurred frequently. For example, at 2 pm on February 15, 2012, a 5-liter formaldehyde reactor leaked in a university laboratory in Nanjing [5]. Lab safety issues have attracted the attention of governments and scholars.

Preventing work based on the cause of the accident is the only way to avoid the accident from happening again. According to a research survey conducted by Tzu Chi University in Taiwan, the proportion of accidents caused by anthropic factor in lab safety accidents is 98% [6]. This shows that the effective prevention and control of laboratory accidents depend mainly on the prevention and control of anthropic factor in the laboratory. Researchers have conducted extensive investigations and analysis of lab insecurities [7-13], but there are few studies investigating into anthropic factor affecting lab safety. For this, the paper conducts a questionnaire survey of the main participants of the experiment, college students, to grasp the current students' familiarity with the safety knowledge of the laboratory and the familiarity of safety behavior, and to analyze the differences of safety culture and behavior of students with different knowledge background.

Methods

Questionnaire Topic

The contents of the survey as shown in Table 1, mainly includes three parts: (1) Personal information; (2) The awareness of lab safety knowledge; (3) Proficiency in safety behaviors.
Sample

Students from Wuhan University of Science and Technology were selected to fill out the questionnaire for the respondents. The questionnaire was issued on May 2, 2016, and 482 questionnaires were collected on May 16, 2016. There was no phenomenon that the answer at random, 482 valid questionnaires, the effective response rate was 100%.

<table>
<thead>
<tr>
<th>Item</th>
<th>Part A: personal information</th>
<th>Part B: the awareness of lab safety knowledge</th>
<th>Part C: proficiency in safety behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>What is your college?</td>
<td>B1: Have you noticed there is a risk of possible drugs, equipment, etc.?</td>
<td>C1: Are you checking the device before the experiment?</td>
</tr>
<tr>
<td>A2</td>
<td>Your gender?</td>
<td>B2: Do you know the storage location of the lab firefighting supplies?</td>
<td>C3: Would you leave during the experiment?</td>
</tr>
<tr>
<td>A3</td>
<td>What grade are you in?</td>
<td>B3: You know the routine laboratory hurt proper protection and approach it?</td>
<td>C6: What would you do when a safety accident occurs in the lab?</td>
</tr>
</tbody>
</table>

Research Analysis

Research Object

The survey of research objectives is shown in Fig1. Based on how many hours of experiments to distinguish between students’ experimental experience. The Experimental hours greater than or equal to 6% of total hours divided into experimental more specialized professionals; Less than 6% of the total hours of majors are classified as less specialized. Experimental survey of experienced accounting for 70.54%. The survey objects of undergraduate students accounted for 92.53% and graduate students accounted for 7.47% according to the study period.
Analysis of the Cognition Degree of Lab Safety Knowledge

Note Whether there is a Risk of Possible Drugs, Equipment and so on. As shown in Fig. 2, 49% of students often pay attention to drugs and instruments that are at risk in the experiment. 46% of students sometimes pay attention, and very few students do not pay attention to the experimental risk. Indicated that students have a strong sense of risk and can understand the dangers in the experiment through the existing safety knowledge.

Whether Know the Proper Protection and Treatment of Laboratory Accidents. As shown in Fig. 3, 21% of students are very familiar with the treatment, and 70% of the students know how to handle the accident. Indicated that most of the students on proper laboratory accident prevention and treatment methods inadequate understanding.25% of the graduate students are very familiar with the treatment method, and 16.59% of the undergraduates are very familiar (as shown in Fig. 4), indicating that graduate students have more knowledge about accident handling than undergraduates.

Analysis of the Mastery of Lab Safety Behavior

Whether to Inspect the Device before the Formal Experiment. As shown in Fig. 5, only 7% of the students never checked the device before the experiment, and 51% of the students always checked the device before the experiment. Explain that students behave more conservatively in checking the safety of the device. As shown in Fig. 6, 55.56% of graduate students will check device inspections, which is higher than undergraduate students (43.27%), and only 2.78% of graduate students are never
examined, and the proportion is far below the undergraduate students who account for 10.76%. Explained that graduate students pay more attention to device security.

**Reaction in the Event of a Safety Accident in the Lab.** As shown in Fig. 7, regardless of the experimental experience, the handling of the accident is almost the same. As shown in Fig. 8, 49.78% of undergraduates are the first to inform the teacher when an accident occurs, and 63.89% of graduate students choose to handle it themselves. It shows that graduate students have more comprehensive knowledge and stronger independence.

![Figure 7. Differences in Experimental Experience and Reaction in Lab Accident.](image)

![Figure 8. Differences in Educational Level and Reaction in Lab Accidents.](image)

**Conclusions**

Through the analysis of the relevant factors and personnel's understanding of safety culture and the mastery of safety behavior, the reasons for these differences are as follows:
(1) Graduate students are more aware of safety culture than undergraduates.
(2) Postgraduates have higher education levels and are more rigorous in their experiments and more focused on the accuracy of the experiment.
(3) Students with rich experimental experience are less mastered in safety behavior than students with less experimental experience.

**Education Strategy**

Based on the above conclusions, to effectively avoid the occurrence of laboratory safety accidents induced by human factors in two specific groups of undergraduate and postgraduate students, the following education strategies are proposed:

1. Through systematic and scientific laboratory safety knowledge popularization education to improve the safety knowledge and safety awareness of experimental personnel.
2. Through the standardized and regular laboratory safety accident drills to train the experimenters’ psychological quality when facing the accident, strengthen the experimenters’ emergency ability to deal with accidents, to improve the self-rescue ability of experimenters once an accident occurred, and reduce loss in accident.
3. Through standardized and strict laboratory rules and regulations to strengthen the management of the experimenters, and improve the experimenters understanding of the safety culture and being aware of safety behavior.

**References**


