

Reason Analysis of Security Accidents and Advice of Safety Education in College Metalworking Practice

Shumei Zhu^a, Wei Liu^{b*}, Yanhui Qiao^c and Zhenwu Ma^d

Suzhou University of Science and Technology, Suzhou, China

^azhushumei_sust@qq.com, ^bliuwei_sust@qq.com, ^c491106706@qq.com, ^dmazw@usts.edu.cn

*Corresponding author

Keywords: Engineering training; Security accidents; Accident analysis; Safety education

Abstract. With continuous transformation and upgrading of manufacturing industry, the comprehensive engineering training and innovative abilities of engineering college students are demanded to rise. Metalworking practice course provides students with equipment operation and an opportunity of applying theory to actual production, which is an important way to improve the comprehensive abilities of students in the undergraduate stage. However, how to keep security during the process of the course has always been the most important and difficult problem. Combined with authors' experience of guiding students in metalworking in the past years, this paper analyzes the cause of accidents and presents some specific suggestions to improve the safety education and management in practice.

1. Introduction

Chinese manufacturing has been gradually changing from extensive form to high-tech form in recent years. The higher requirements of engineering graduates are given in comprehensive abilities, including abilities of utilizing overall knowledge and solving actual problem, actual equipment operation and practice. As a required course for engineering students, the metalworking practice course is one of the most important ways of training these abilities. Different from other courses, most of the time is cost in operating equipment. Much equipment runs at high speed and may cause suddenness hurt accidents. So, safety is the most important aspect of metalworking practice. As the numbers of equipment and students increase, the security guarantee in practice is more difficult [1]. Based on our years of experience on guiding students, this paper firstly states the content of security assurance in metalworking practice, then analyzes the reasons of accidents and gives some advice of improving safety education.

2. Content of security assurance in metalworking practice

(1) Ensuring students' personal safety

Students are the direct participants in metalworking practice. Because they generally lack safety knowledge, ensuring students' personal safety is the premises and top priority of metalworking practice implementation, which influences the teaching effect directly and is the precondition of practice.

(2) Ensuring teachers' personal safety [2]

Ensuring teachers' personal safety is another precondition of metalworking practice implementation. The practice teachers are the key personnel in metalworking practice. In teaching process, teachers often operate equipment in high-speed cutting, high-temperature, high-pressure environment. The complicated work environment and dangerous equipment easily cause personal injury accidents such as scald, hit and twine. So, it is very necessary and essential to strengthen and regulate laboratory safety management, establish safe operation procedure and take precautionary safety measures and emergency plan.

(3) Ensuring safety of equipment and property [3]

Experiment equipment and instrument are important tools of teaching and researching in colleges and universities, and also play an important and irreplaceable role in training students' comprehensive ability and innovative thinking. With the implementation of national and provincial teaching reform and open laboratory policies, a large amount of money is spent on experiment equipment and instrument. For avoiding the device damage accidents caused by wrong operation, it is necessary to build a series of safety regulation of equipment operation to ensure safety of equipment and property.

The particularity of metalworking practice makes there are a lot of unsafe factors in every section. Any carelessness may well cause security incidents and serious bodily injury. Only ensure safety of students, teachers, equipment and property, metalworking practice, teaching and researching could go on wheels.

3. Reason analysis of security accidents

The content of metalworking practice mainly includes physical surveying, turning, milling, bench worker, drilling and other basic cutting. Before metalworking practice, most students do not have access to large-scale mechanical equipment and lack related safety knowledge. Even if they receive safety education, they can hardly get familiar with equipment and operate device according to specifications very soon, which makes it hard to eliminate potential safety hazards. The reasons of safety accidents can be classified as objective and subjective factors. Objective factors mainly include the following contents:

(1) Practice environment

Unreasonable laboratory location and design, non-standard wires, unstable joints, loud noise, bad lighting and ventilation can easily cause accidents.

(2) Mechanical equipment

Large-scale mechanical equipment (such as turning-lathe, milling and grinder machine) used in metalworking practice are designed for mass industrial production, and there are not enough important signs and warning marks for practice teaching. Besides, additional safety devices are also urgently required. In students' operating process, mechanical equipment can hardly always works normally. If teachers get weak supervision, security incidents are likely to occur, which causes students' personal safety injury and equipment damage.

(3) Protective equipment [4]

In practice, necessary protective equipment is very important to ensure students and teachers safety. The lack of protective equipment cannot reduce damage effectively when accidents occur.

Subjective factors mainly include the following contents:

(1) Students factors

With poor safety awareness and insufficient preparation, students may well operate device incorrectly in a cognitive state of curiosity. In the practice process, students may have fluke mind in safety, panic, anxiety and slacking. For example, students need to complete projects by hand, which is great labor intensive, consumes an amount of physical energy and especially tests endurance and patience. Some students have poor physical quality. They are more likely to get physical discomfort and negative work. Some students are impatient and their skin is often scratched when sawing and filing. Though skin scratching is not severe, we should also take relevant measures as precaution.

(2) Teachers factors

On the one hand, some teachers work in laboratory for long time. The familiar working environment easily makes they feel good about themselves and neglect safety [5], which makes their guard down. When they get blind confidence and a lack of preparation before practice, they may well not follow safe operation procedures and simplify operation process. Ignoring safety procedures could well lead to a security accident [6]. On the other hand, because there are many students in class, teachers can only give an integral introduction of potential security problems and disposal methods. When students get misoperation, they may be not familiar with emergency measures and too nervous to do proper disposal. And few teachers can hardly go to the accident scenes in time to protect students completely.

Through the above analysis, there are many reasons causing various accidents. However, taking reasonable precautions can avoid most accidents and reduce damage to the minimum.

4. Advice and measures of safety education in metalworking practice

For the above accident causes, based on our years of experience on metalworking practice, some advice and measures are given as following:

(1) Various safety educations

Firstly, considering the particularity of metalworking practice, teachers should tell students practice arrangement, steps and ranking criteria in great detail. Rules and regulations of the laboratory should be emphatically introduced. Multimedia courseware and safety education videos can show safety knowledge intuitively. Students are arranged to communicate with former students and can harvest useful experience. Secondly, excellent practice works are shown to students. Based on the works, teachers explain device operation, technological process, processing method and basic principles of safe operation. At last, strict dress requirements are emphasized: wear long pants and long sleeves; fasten the buckles of cuffs and collar; hoodie is forbidden; girls must wear hats and long hair must be tied up and tucked into hats; wear sports shoes in practice places; wear safety glasses, gloves and masks in special types of work.

(2) Safety management throughout the whole process [7]

Firstly, many students do not have access to large-scale mechanical equipment before metalworking practice. They generally have a strong sense of curiosity but poor self-discipline ability. They are naturally eager to expressing themselves, which easily causes some breaches of the procedures, for example, not keeping classroom discipline, using unauthorized device and fiddling with handles and buttons of equipment. For avoiding the conditions, teachers should tell students discipline requirements of laboratory in advance according to the schedule, and emphatically repeat the discipline in the process. Rules of rewards and punishments are necessary to regulate the behavior of students. Every group has a safety leader as a supervisory role. Secondly, though students have seen safety videos, courseware and examples and known accidents can bring severe physical injury, in order to further reduce the accident probability, they still need to study equipment safety operation regulations and cautions, especially usage of scram button in all kinds of devices. At last, many devices are similar in theory and construction. As the most basic mechanical cutting, turning is emphasized and demonstrated the machining principle, lathe structure, functional units and keys of safely operation. After students are familiar with turning-lathe, teachers then explain milling machine and emphasize the differences from turning-lathe, for example, different usages of handles and buttons, different places misoperation happens, and different emergency measures. By comparing the differences, students can better master the standard operation of different equipment. Besides that, every student is required to check the equipment condition before operation and forbidden to operate equipment when other students use.

(3) Strengthening teacher's training

More and more devices are purchased to improve experiment condition. Some of them are new and strange to teachers. So necessary training is very important for teachers to be quickly familiar with new devices. On security, teachers should receive more first aid training to reduce physical injury when accidents happen [8]. In order to renew knowledge, universities should regularly organize teachers to attend professional training courses. And teachers also need to communicate with each other.

(4) Participating in social insurance [9]

If students have injury accidents, accident responsibility and compensation will inevitably cause disputes between students and universities. Social insurance can be used to spread risks. Universities and students can participate in social insurance for compensation. Both can reduce damage to the minimum by social insurance.

5. Summary

Metalworking practice is a very important process in university's teaching courses and basic part of engineering training. High-quality metalworking practice can not only educate students to establish right concept of labor and improve comprehensive engineering abilities, but also train and develop innovation ability. For ensuring the practice safety, this paper analyzes reasons of accidents and presents measures of safety education. The measures have good operability and can reduce the accident rate effectively, which supports security of metalworking practice.

Acknowledgement

This research was financially supported by the Curriculum Teaching Comprehensive Reform Project of Suzhou University of Science and Technology (NO.2018KJZH-55).

References

- [1] D. Zeng, M. Yu, and G. J. Ma, Safety accident analysis of metalworking practice and management advice for students majoring in ship and ocean engineering in higher vocational colleges, *Vocational Education*, No. 5, pp. 51-53, 2018. (In Chinese)
- [2] Y. Wang, Talking about measures of university laboratory safety, *Research and Exploration in Laboratory*, No. 9, pp. 183-185, 2010. (In Chinese)
- [3] K. B. Lu, Discussion on university metalworking laboratory safety management system construction, *China Modern Educational Equipment*, No. 13, pp. 45-47, 2015. (In Chinese)
- [4] A. L. Feng, Research on prevention of injury accidents in college students' experimental practice, *China Electric Power Education*, No. 24, pp. 114-115, 2008. (In Chinese)
- [5] L. Yang, Investigation of personal protection in chemical laboratory, *Research and Exploration in Laboratory*, No. 5, pp. 186-188, 2011. (In Chinese)
- [6] W. C. Dong, and W. Zhang, Analysis of typical accidents and security countermeasure in metalworking practice in colleges and universities, *Research on Laboratory Work in Universities*, No. 4, pp. 88-89, 2017. (In Chinese)
- [7] R. S. Xu, Y. C. Xiang, and X. L. Ma, Application of metalworking practice in safety system engineering teaching, *Safety*, No. 7, pp. 54-56, 2017. (In Chinese)
- [8] R. R. Liu, Talking about the safety management of metalworking practice base in our university, *Heilongjiang Science and Technology Information*, No. 13, pp. 148. 2007. (In Chinese)
- [9] R. Liu, X. Y. Zhu, and L. L. Duan, Analysis and Precaution Against Hidden Danger During Engineering Training, *Modern Society*, No. 6, pp. 90-91, 2014. (In Chinese)