

ANALYTICAL STUDY OF SURVEY RESULTS OF CHEMICAL SAFETY AND SECURITY CURRICULUM IN IRAQI ACADEMIC INSTITUTIONS

Christine M. Straut¹, Wedad H. Al-Dahhan², Hadi S. Al-Lami³, Falah H. Hussein⁴, and Emad Yousif ^{2*}

¹Sandia National Laboratories, Albuquerque, New Mexico, USA

²Department of Chemistry, College of Science, Al-Nahrain University, Baghdad, Iraq

³Department of Chemistry, College of Science, University of Basra, Basra, Iraq

⁴College of Pharmacy, University of Babylon, Babylon, Iraq

e-mail: emad_yousif@hotmail.com

Abstract

The survey presents a general view of the reality of chemical security and safety in educational institutions in Iraq, in which about 301 university staff from 14 Iraqi universities includes a doctorate, master's and bachelor's degree with a postgraduate student presented their opinions regarding the survey sections. This included basic information related to security and safety curricula and their teaching to students of primary and higher studies in Iraqi universities and ways of communication between universities to improve the reality of teaching and training. These institutions possess a culture of safety and optimal training methods for trainers and students. The opinions of the residents varied, which indicates the disparity of university institutions in terms of performance and infrastructure to improve the reality of security and safety in their institutions. We suggest that the Ministry of Higher Education's decision-makers take the results of the survey into account to develop future plans and improve the reality of security and safety. Furthermore, it is required to address the negatives and enable universities to communicate with each other to exchange experiences. It is important to take into account the adoption of the principle of transparency in the dissemination of data that would enhance aspects of education and knowledge in educational institutions.

Keywords: survey; safety; security; academic institutions

INTRODUCTION

A safety culture has been developed all over the world using chemical industry laboratories, and the academic community has been involved in developing the handling and management of chemicals safely, which results in the development of a "safety and security culture" and making work in laboratories within a safe environment[1].

The safe and secure laboratories in academic institutions require a shared commitment to and effort from all people to prevent and respond to an accident. The culture of chemical security and safety are usually well recognized around the world in these institutions.

Most of academic institutions developed their safety and security systems according to their needs, a number of them are still in need of such

development. The administrative structure of the institution must include a number of employees who have experience and take responsibility for maintaining a safe laboratory environment. Advance planning for chemical experiments, including reporting of chemical theft and suspicious activities, is very important to maintain laboratory and institution security [2].

Officials are needed to plan and implement safety aspects in educational institutions to improve the reality of their institutions in terms of security and safety .The researchers had a great effort in spreading and spreading the culture of safety and supporting their institutions with a number of publications that contributed to evaluating laboratories [3] and evaluating performance in research laboratories [4].

The term "chemical security" refers to measures to prevent the intentional release of toxic chemicals and mitigate the impact on the environment. In a broader context, the issue may include special policies to prevent access to toxic chemicals that could be used in the manufacture of chemical weapons [5]. It should be noted here the commitment to the ethical aspects of work and transparency in dealing, which results in a clearly defined and safe work environment to the extent that guarantees the safety of workers and the workplace [6]. This survey presents a general view of the reality of chemical safety and security in educational institutions in Iraq.

METHOD

This research uses the method as students presented their opinions regarding the survey sections.

About 301 university staff from 14 Iraqi universities (see table 1) includes a doctorate; master's and bachelor's degree with a postgraduate student presented their opinions regarding the survey sections.

The survey of Chemical Safety and Security at Academic Institutions consists mainly of four main sections. This paper highlights the importance of the main section "Current chemical safety and security curriculum for undergraduate and graduate students". The participant in this survey research as presented in Table 1.

Table 1. Participants in Survey of Chemical Safety and Security at Academic Institutions

University	Participants
University of Basrah	92
University of Babylon	38
University of Diyala	26
Nahrain University	24
University of Qadisiyah	17
University of Fallujah	16
University of Baghdad	14
University of Thi-Qar	14
Tikrit University	13
University of Technology	13
Al-Mustaqbal University	12

College	
University of Amarah	11
Al-Qasim Green University	10
University of Kufa	1
Total	301

RESULTS AND DISCUSSION

Current chemical safety and security curriculum for undergraduate and graduate students discussion based on main factors include: training, teaching, laboratory courses, guest Lecturers and case studies related to chemical safety sharing in coursework or laboratories.

1. Training on chemical {safety/security}

Chemical safety training in the workplace has a lot of benefits, including reducing the risk of accidents through the use of hazardous chemicals by ensuring full compliance with relevant global safety regulations [7].

In recent years, there has been a noticeable interest in receiving safety training, and this may be due to the serious interest of higher administrations in the importance of these training courses, or through the central instructions directed by the ministry regarding the importance of the subject. As a result, the percentage of 69% (see Figure 1) supported the demand, and it requires confirmation of the 21% by the responsibility centers to implement this requirement by educational institutions.

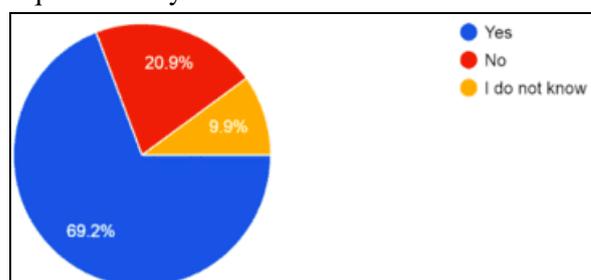


Figure 1. Percentage of faculty members/teachers receiving any training on chemical safety

In terms of security, security awareness training helps to minimize risk. Training in local and international programs is often compatible with safety training, so the results as shown in Figure 2 were close to the security and safety aspects.

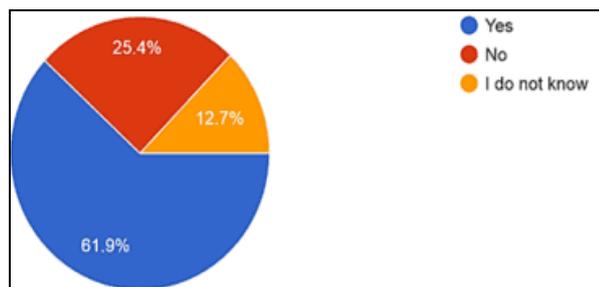


Figure 2. Percentage of faculty members/teachers receiving any training on chemical security

2. Teaching chemical (Safety / Security) to undergraduate and graduate students

Staff training is very important and provides an opportunity to gain knowledge as it relates to the materials and tools used. It gives the opportunity for learners to participate in questions that deepen the basic information. (University of Colorado).

Safety principles should be taught to students early on and developed continuously during their studies. Safety education in chemistry has been imposed in some universities mainly and is reinforced by training courses according to innovations and needs. [8].

Chemistry students need to be involved in the practical side of the laboratories as this will greatly help them understand the complex theories and principles of chemistry courses. These classes will help students develop research and provide opportunities for them to learn how to handle chemicals safely. In addition, they will gain experience in using chemical devices and develop skills. [9].

However, teaching in academic institutions is heavily focused on safety; the percentage of the referendum converging is depicted in Figures 3 and 4. We can attribute this to the fact that the referendum adopted a yes or no scale, and this will certainly generate inaccurate results since teaching for the term chemical security is limited. This does not negate its comprehensiveness in teaching, and here the answer will be yes, with limitations in the axis of security in teaching.

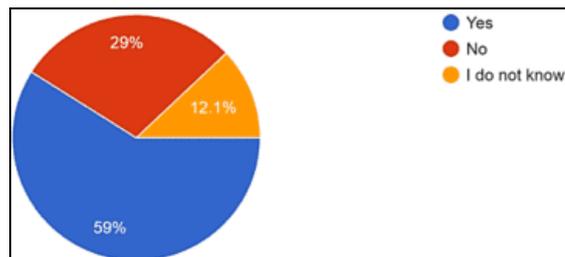


Figure 3. Percentage of undergraduate students currently taught chemical safety

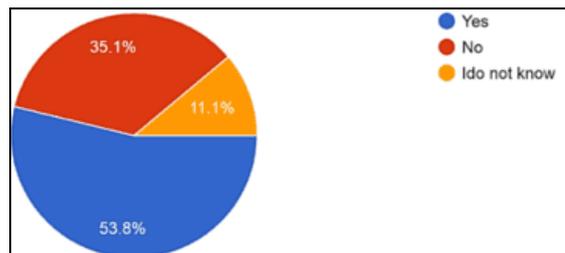


Figure 4. Percentage of undergraduate students currently taught chemical security

Postgraduate students do not study a curriculum dedicated to safety, but education in this regard is provided through specialized courses before starting the research. The results of the questionnaire are presented in Figures 5 and 6.

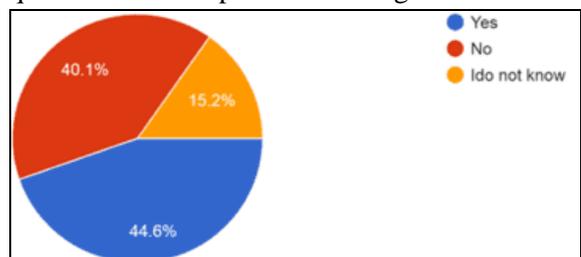


Figure 5. Percentage of undergraduate students currently taught chemical safety

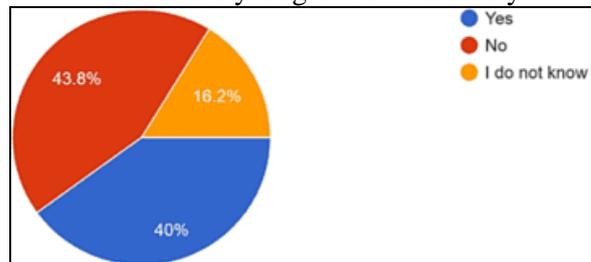


Figure 6. Percentage of undergraduate students currently taught chemical security

The opinion confirmed that the courses are the approved method for education as shown in Figures 7 and 8. It is worth noting that there are up to 28 % of graduate students did not take security and safety courses and before starting research.

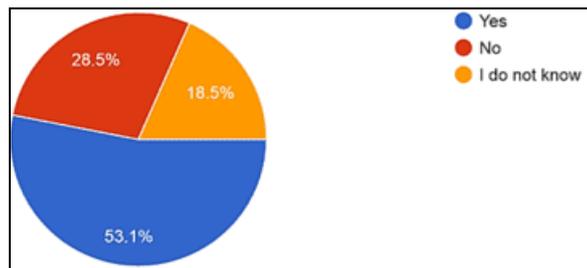


Figure 7. Percentage of graduate students currently taught chemical security

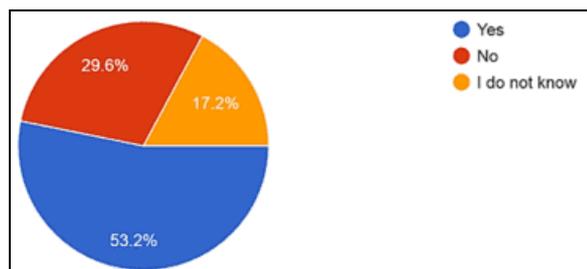


Figure 8. Percentage of graduate students currently taught chemical security

3. Student courses / laboratories including topics of chemical (safety / security) in the institution

Chemistry has increased our understanding of the physical and biological fields as well as our ability to manipulate them over the past century. With the continuation of the work done in chemistry laboratories at the global level, it has led to important advances in science and engineering. The chemical laboratory has become an important center for acquiring and developing knowledge, and for monitoring and controlling chemicals used in thousands of commercial operations on a routine basis. Most of the chemicals produced are very beneficial but some also have the potential to harm human health and the environment. Chemists must be aware of the intentional misuse of chemicals. Laboratories and educational institutions face many threats, including the theft of sensitive and important information or the negative use of equipment or chemicals in the production of weapons or drugs. [10].

The results of the survey were identical to the reality in that the holding of courses on a

permanent and continuous basis rarely happens in educational institutions and that the percentage of 22% is realistic, while the large percentage of 45% is sometimes, noting that there are 10% that do not hold courses. This is an indicator that there are educational institutions that do not give any importance to this topic. The results of this section are shown in Figures 9 and 10.

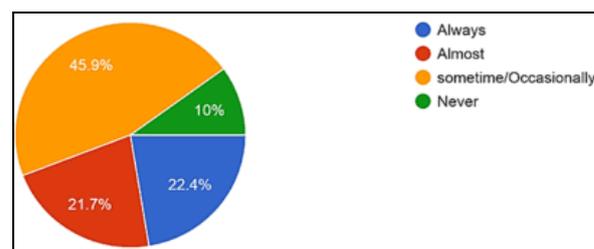


Figure 9. Percentage of student courses/laboratories including topics of chemical safety in the institution

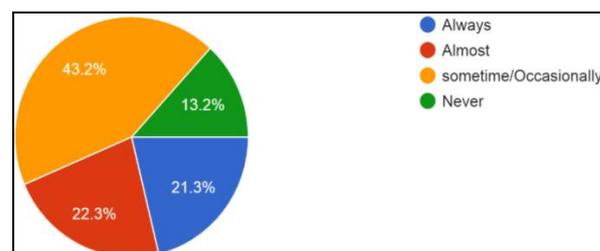


Figure 10. Percentage of student courses/laboratories including topics of chemical security in the institution

4. Case studies related to chemical safety sharing in coursework or laboratories

Adopting the subject of the case study is very important in all educational aspects and security and safety aspects in particular. We believe that the percentage here is modest, as shown in Figures 11 and 12, which indicate the limited capabilities of the lecturers to evoke local or international case studies. This can also be achieved through the practical experience of the lecturer to achieve the educational goal by supporting theoretical aspects with realistic examples and scientific analysis. Researchers on this subject respond with the reservation of educational institutions to publish some accidents that occur in laboratories to preserve the reputation of the institution and for fear of

accountability. It greatly requires the adoption of transparency in the presentation of cases for the sake of supporting educational goals.

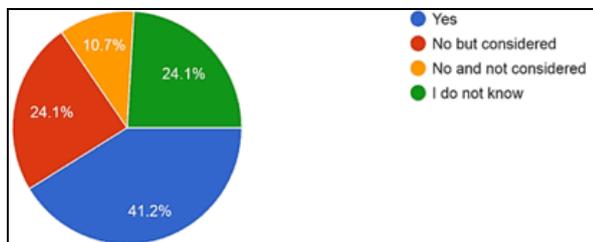


Figure 11. Percentage of case studies related to chemical safety sharing in coursework or laboratories

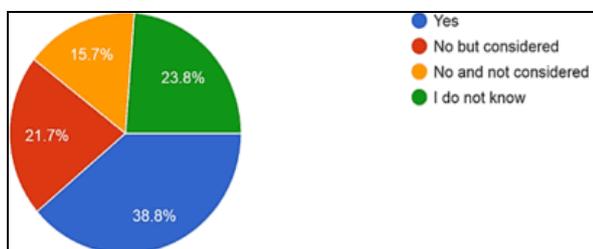


Figure 12. Percentage of case studies related to chemical security sharing in coursework or laboratories

It should be noted here that the “I don’t know” indicator is very high, which indicates that those who submit the survey information either did not give lessons in security and safety or they do not know what is happening in their institutions.

5. Guest Lecturers brought into classrooms or laboratories to teach any aspect of the curriculum related to chemical {safety/security} to students

The results shown in Figures 13 and 14 indicate that weak cooperation between educational institutions in terms of exchanging experiences and involving others in a way that enhances educational aspects and openness to all institutions in order to support educational goals in terms of safety and security.

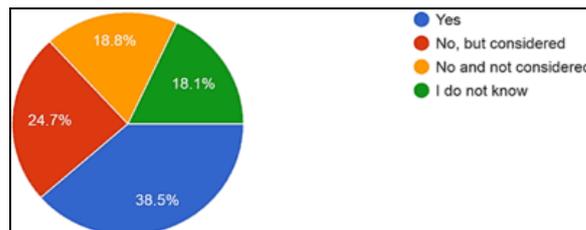


Figure 13. Percentage of Guest Lecturers brought into classrooms or laboratories to teach any aspect of the curriculum related to chemical safety for students

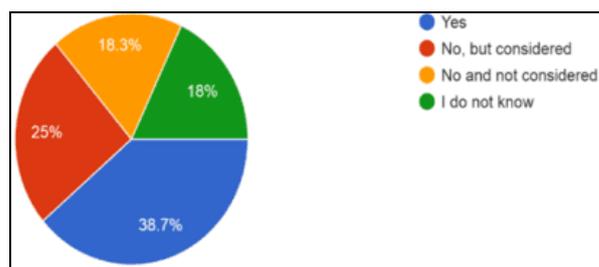


Figure 14. Percentage of Guest Lecturers brought into classrooms or laboratories to teach any aspect of the curriculum related to chemical security for students

Noting that there is a percentage of about 18%, of the survey was not considered. This is a negative indicator in terms of lack of interest in such an important factor in consolidating the educational process, with confirming our previous observation in section 1.5 about the high percentage of “I don’t know”.

Results related to this section of the survey show the low rates of students receiving lessons outside of the educational institution. This confirms the conclusion on about the weakness of cooperation and communication between educational institutions as indicated in Figures 15 and 16.

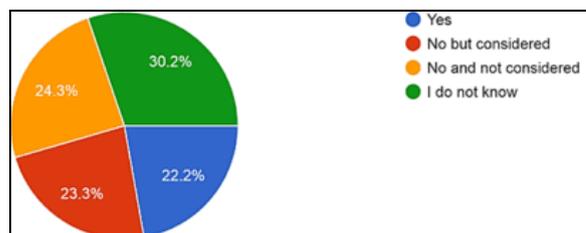


Figure 15. Rates of students receiving lessons outside the educational institution related to chemical safety

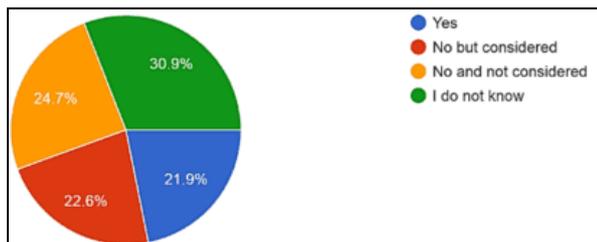


Figure 16. Rates of students receiving lessons outside the educational institution related to chemical security

6. Chemical {safety/security} training

The concept of training students (for example, new students) in the university and their knowledge about the requirements and conditions of chemical safety and security during their studies within or outside the university is one of the necessary things to prevent or minimize incidents on humans and the environment, as well as terrorist incidents that target the community and the country [11].

Training is very important, especially in upgrading the skills of staff and students in the field of security and safety. The results of this survey within this section came with two main indicators. The first is about 25% support, lack of experience, and this indicator can be overcome through the training of the staff through the exchange and strengthening of experience from outside the educational institution. The second is a dangerous indicator that 27% support the lack of importance of the section and here specifically the role of leadership in guidance and responsibility to advance the important concepts in the aspects of security and safety. Figures 17 and 18 show the results of chemical safety and security training survey data, respectively.

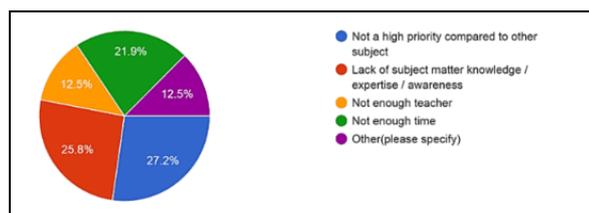


Figure 17. Percentage of Chemical safety training in the educational institution

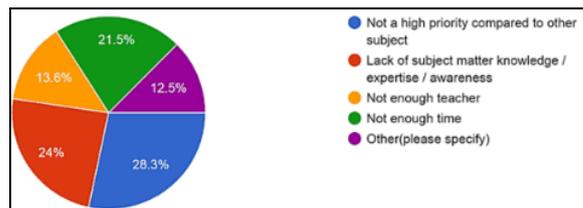


Figure 18. Percentage of Chemical security training in the educational institution

On a related topic, many teachers supported the need to receive training through full training courses at the beginning of education for the student, and this is very important in that the student will receive the appropriate training before starting the practical part in the laboratories. Figures 19 and 20 indicate that more than 70% of the students' forms, regardless of the details of the process, support the necessity of receiving such training.

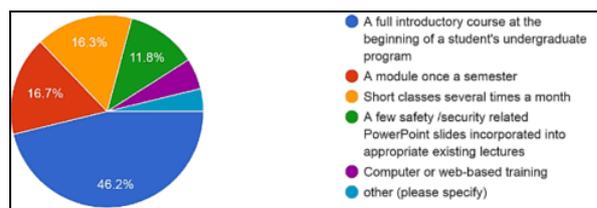


Figure 19. The forms of Chemical safety training required for students with their percentage in the educational institution

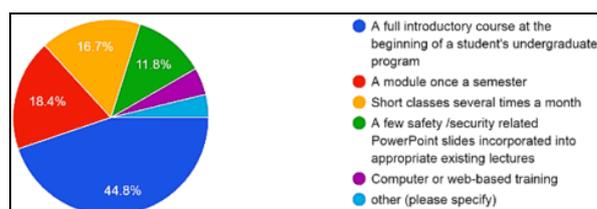


Figure 20. The forms of chemical security training required for students with their percentage in the educational institution

7. Owning the institution and the culture of chemical {safety/security}

The culture of security and safety has developed with new concepts through organization and education all over the world in the chemical laboratories of factories and in academic circles. This resulted in the development of a "culture of

safety and security", which provides a safe work environment. [12].

Although it is a good indicator that the percentage is about 57% of those who strongly support and support their institutions' possession of a culture of safety, the remaining percentage cannot be neglected in that 26% of educational institutions do not have a culture of safety. Here, the role of university leaders and the ministry emerges by emphasizing their institutions to give the issue of safety and its culture the required importance. Figures 21 and 22 show the percentage of the institution owning the culture of chemical safety and security, respectively.

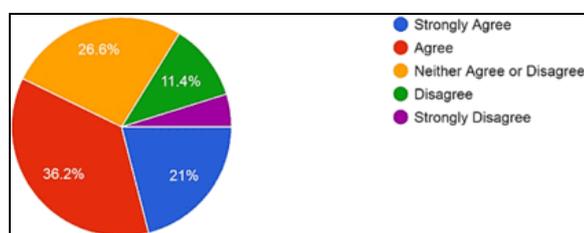


Figure 21. Percentage of the institution owning the culture of chemical safety

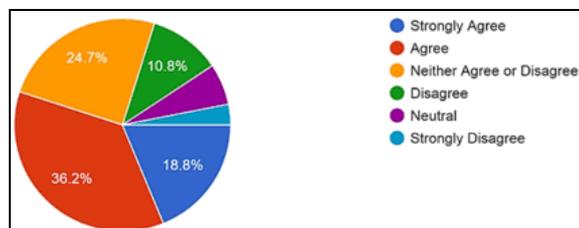


Figure 22. Percentage of the institution owning the culture of chemical security

Teaching chemical security and safety is one of the most important methods adopted in academic institutions to raise the level of safety culture and its direct impact on the performance of teachers and students in laboratories. About 65% supported teaching safety as a compulsory subject for primary and higher studies, as shown in figure 23 for safety and figure 24 for security teaching, respectively.

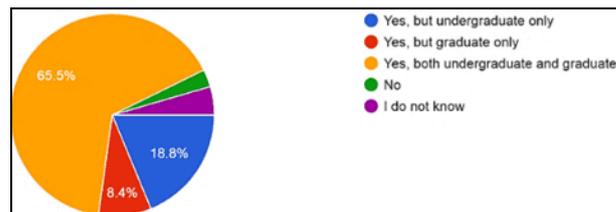


Figure 23. The percentage of voting on the mandatory teaching of the safety course

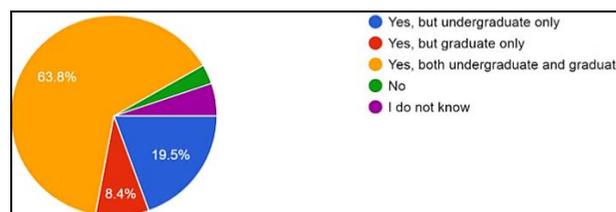


Figure 24. The percentage of voting on the mandatory teaching of the security course

CONCLUSION

The survey provided a general view of the reality of security and safety in educational institutions in Iraq. In general, it can be concluded that educational institutions vary in their procedures regarding the application of security and safety standards, and the ability of their staff to manage this file in its various aspects varies. Some sections in this survey showed a significant percentage that the reviewer does not know a number of the survey paragraphs, which indicates the limited exchange of general information in academic institutions, in addition to the existence of a situation that cannot be bypassed, which is that some institutions do not give the issue of security and safety the required attention, which requires the decision makers to bear their responsibilities to advance this vital axis in order to preserve the safety of their institutions and to graduate qualified students armed with a culture of chemical security and safety.

ACKNOWLEDGMENT

We would like to thank Sandia National Laboratories for their sponsorship and support for this survey, which serves the development of educational methods and enhances security and safety measures in Iraqi educational institutions.

REFERENCES

1. Chemical Laboratory Safety and Security: 2016. *A Guide to Prudent Chemical Management*, www.nas.edu/bcst.
2. Ahmed, F. 2019. *Chemical Safety and Security Challenges in Academic Institutions in Developing Countries*, Chapter 6, <https://pubs.acs.org/page/policy/sharingguidelines>
3. Rasool, S., Al-Dahhan, W., Al-Zuhairi, A. Hussein, F., Rodda, K. & Yousif E. 2016. Fire and Explosion Hazards expected in a Laboratory. *Journal of Laboratory Chemical Education*, Vol. 4, No. 2, pp. 35-37.
4. Al-Dahhan*, W., Al-Zuhairi, A., Yousif, E., Rasool, S. & Hussein, F. 2017. Bad filling ionic liquid sample in split tube furnace. *Interdiscip J Chem*, Vol. 2, No.2, pp. 1-3.
5. Organization for the Prohibition of Chemical Weapons (OPCW) . 2022. *Capacity Building, Chemical Safety and Security Management Programme*.
6. Al-Dahhan, W., Ali, A., Rodda, K., Alkaim, A., Hussein, F. & Yousif, E. 2020. Moral Integration and Transparency as Cornerstone of Safety in Chemistry Laboratories, *International Journal of Psychosocial Rehabilitation*, Vol. 24, No. 5, pp. 1792-1796.
7. Gillian 2019. Safety Training-EcoOnline, Chemical Safety Training, <https://www.ecoonline.com/blog/chemical-safety-training#:~:text=There%20are%20a%20number%20of,the%20use%20of%20chemicals%20and>
8. Hofstein, A. & Rachel, M. 2007. The Laboratory in Science Education, the State of the Art. *Chemistry Education Research and Practice*, Vol. 8, No. 2, pp. 105-107.
9. Ziara, K., Ibraheem, A. & Al-Furaiji, A.2021. Chemical Safety Awareness for Undergraduate Analytical Chemistry Students: A Case Study at Baghdad University, Republic of Iraq. *Saudi J. Humanities Soc Sci*, Vol. 4, No. 4, pp. 30-35.
10. National Research Council of the National Academies, Executive Summary .2011. *Chemical Laboratory Safety and Security*,
11. Al-Jboory, H. & Al-Khalaf, A. 2017. Training Programs for Students on Chemical Safety and Security: Al-Qasim Green University as a Case Study. *Iraqi National Journal of Chemistry*, Vol.17, No. 3, pp. 178-183.
12. University of Colorado. Chemical Safety, Chemical Safety Training, <https://www.colorado.edu/lab/chemistry-safety/chemical-safety#:~:text=Chemical%20Safety%20Training&text=Training%20allows%20learners%20the%20opportunity,in%20questions%20beyond%20basic%20information>.