

# Students' awareness of chemical risk on a Mexican campus: The University of Sonora case study

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**Abstract:** Education for Sustainable Development (ESD) is a powerful mean to promotes sustainable development. A decade ago, the UN Decade of Education for Sustainable Development (DESD) promoted this concept to support the creation of a more sustainable future. In 2015, the United Nations launched The Global Action Programme (GAP) to promote the EDS at all levels and in all settings. The University of Sonora in Northwestern Mexico has been engaged in greening its campus by a Sustainability Management System (SMS), which is based on the ISO 14001 international standard. This article is aimed at measuring the awareness of students about safety in chemistry laboratories at the University of Sonora. Despite of being the first university to be ISO 14001 certified in Latin America, findings in this study show that most of the students at the University of Sonora are unaware of key topics of the institutional sustainability management system. Particularly, students are unaware of internal practices for increasing safety in laboratories. A better awareness of the environmental policy and benefits of safety issues among students could be a positive indicator of the relevance of the SMS for increasing the safety within laboratories.

*Keywords:* sustainability, awareness, perception, ISO 14001, students  
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## 1. Introduction

Education for Sustainable Development (ESD) is focused on achieving sustainable development and viewing students as a powerful means to influence sustainable development of our planet and society at large (Fischer et al. 2015: 5-20). This EDS aims at changing the

approach to education that integrates principles, values and practices of sustainable development, and needs to be incorporated into all forms of learning and education (Kitamura 2010: 202-216). A decade ago, the UN Decade of Education for Sustainable Development (DESD) promoted this concept to help create a more sustainable future (UNESCO 2014), but despite the achievements, there remains much to be done. Further the purpose of the DESD, the United Nations launched The Global Action Programme (GAP); one of its goal is to promote whole-institution approaches to ESD at all levels and in all settings (UNESCO 2015).

At the higher education level, sustainability has been integrated in several ways, but environmentally oriented Higher Education Institutions (HEIs) are devoted to develop strategies for the pursuit of sustainability through environmental improvement (Beynaghi et al. 2016: 3464-3478). Particularly in the pursuing of reducing risks in their laboratories because of the number of accidents that occur within those kind of facilities (Drupsteen, Guldenmund 2014: 81-96). Risk has been defined in several ways depending on the context (Zinn 2009: 417-426, Stefan 2011: 41-44). The US Environmental Protection Agency considers risk to be the chance of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor (EPA 2016). The magnitude of the risk is always affected by human behavior in laboratories; for this reason, it is necessary to develop good practices in order to reduce the risk for accidents that might hurt people and environment (NRC 2011: 2-5, CSB 2012).

Often, researchers and students face several risks when using diverse hazardous materials such as chemicals substances, gases, even radioactive material in order to conduct their scientific and academic tasks (Laird 2014: 1777). Trying to protect students, Environmental Management Systems, such as ISO 14001 or/and EMAS, are being implemented on campuses around the world; these frameworks are constituted by practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining university policies of achieving sustainable environments (Alshuwaikhat, Abubakar 2008: 1777-1785)

Despite these expensive initiatives for increasing safety, it is possible that students could feel threatened or at least uncomfortable by studying in unsecure environments. This is because how reality is perceived depending on underlying structures in the mind, structures that are constructed from birth, through infancy to adulthood (Shaw, 2014: 73-89). Perception is known as the experience of obtaining sensory information about the world of people, things, and events and the underlying processes (Hochberg, 2010).

Students' perceptions about their personal likelihood of a dangerous or a risky event may occur in a university laboratory play an important role to increase safety in these facilities. For that reason, HEIs are taking into account their students' perception in order to engage in sustainable practices (Emanuel, Adams 2011: 79-92). It is well known that the perception of any risk is subjective (Lavino, Neumann 2010). Risk perception is affected by the level of awareness and knowledges (Ren et al. 2016: 528-539); but at the same time, perception may drive to risk awareness and preparedness (Landeros et al. 2016: 1515-1537).

This article is aimed at measuring the awareness of students about safety in chemistry laboratories at the University of Sonora. Since 2004, this Mexican higher education institution has been engaged in greening its campus by an environmental management system; which is based on the ISO 14001 international standard (Velazquez et al. 2009: 207-224).

## **2 Methodology**

### ***2.1 Awareness Survey***

A short questionnaire was applied to students regarding their awareness of the institutional sustainability policy, the institutional ISO 14001 certification, the Disposal Practices of hazardous materials, the wastes generated in laboratories, and the accidents in laboratories. The scope of this study was limited to students from the Department of Chemical and Biological Sciences (DCBS) and Chemical Engineering and Metallurgy Department (CEMD) at the University of Sonora in the Northwestern Mexico. The survey was applied to students who had previously taken the Occupational Safety and Environmental Care course that is provided in the first semester of Biological Chemistry Bachelor Degree. In the case of Chemical Engineering, the questionnaire was applied to students who had previously enrolled in the Sustainable Engineering course.

### ***2.2 Sample Design***

The sample design was applied establishing size and distribution sample by statistical random sampling stratified procedures. For the sample size of laboratory users interviewed, a confidence level of 95% ( $Z = 1.96$ ) and an allowable error of 5% were considered. See the following equation:

$$n = \frac{Z^2 Npq}{e^2 N + Z^2 pq}$$

Where:

Z= confidence interval (1.96)

N= total population

pq= constant (0.5)

e= constant (.05)

For DCBS students:

$$n = \frac{Z^2 Npq}{e^2 N + Z^2 pq} = \frac{(1.96)^2 (985)(.5)(.5)}{(.05)^2 (985) + (1.96)^2 (.5)(.5)} = 280$$

For CEMD students:

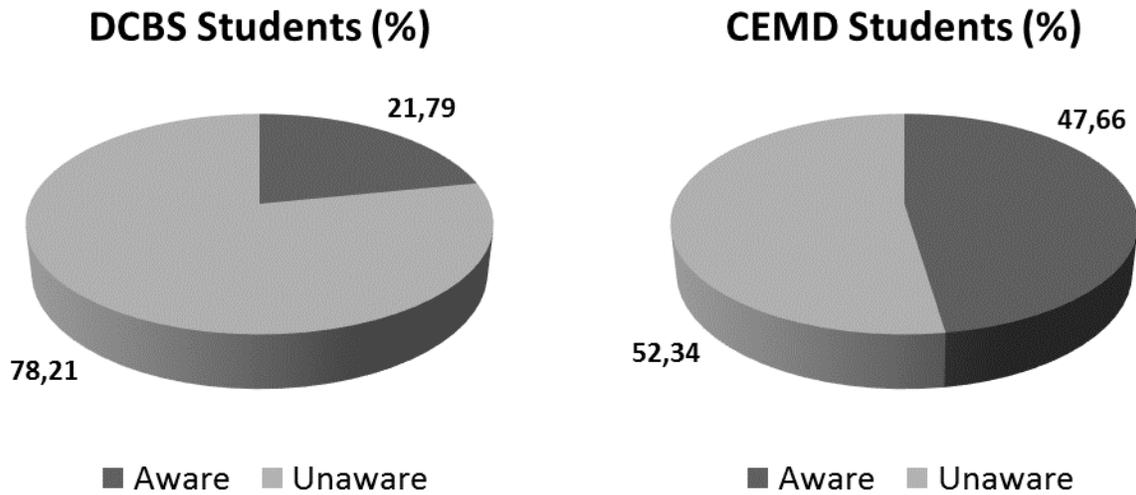
$$n = \frac{Z^2 Npq}{e^2 N + Z^2 pq} = \frac{(1.96)^2 (148)(.5)(.5)}{(.05)^2 (148) + (1.96)^2 (.5)(.5)} = 107$$

### 3 Results

#### 3.1 Survey's results.

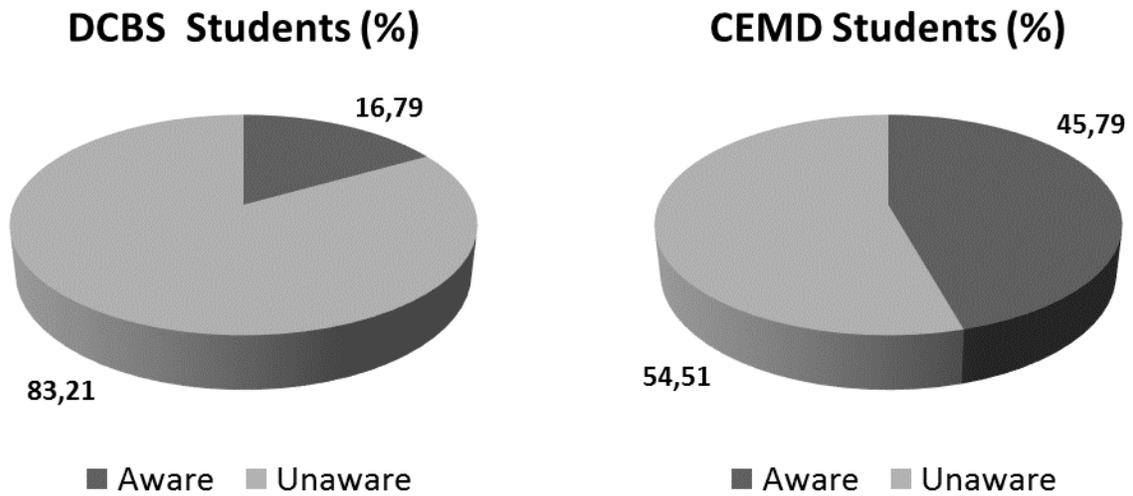
When asked about the institutional sustainability policy, almost 78 percent of the students at the DCBS department were unaware of the existence of such policy; on the other hand, almost 52 percent of the CEMD students knew the existence of the sustainability policy (Figure 1). A vast majority of 83% of the students at the DCBS department claimed to be unaware about the benefits of having an ISO 14001 certification, while for the students at the CEMD department the percentage was about 54 percent (Figure 2). Overall, students seem not to be aware of the existence of an institutional management program for hazardous substances and waste. Roughly 82 percentage of the students in the DCBS answered to be unaware compared to 95 percentage of the students in the CEMD (Figure 3).

Figure 1. Awareness of the sustainability policy



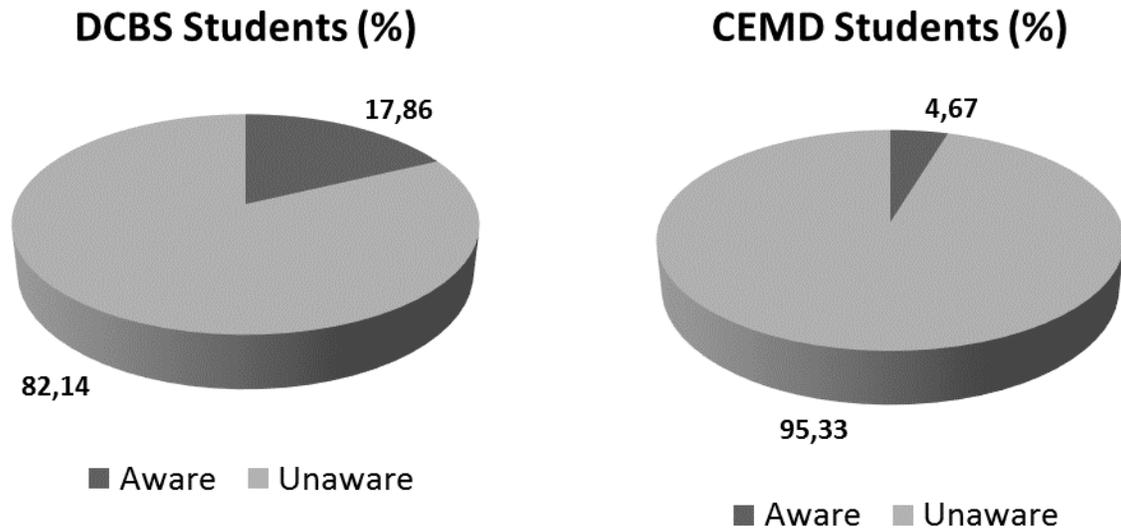
Source: Authors' own elaboration.

Figure 2. Awareness of the institutional SMS-ISO 14001 program



Source: Authors' own elaboration.

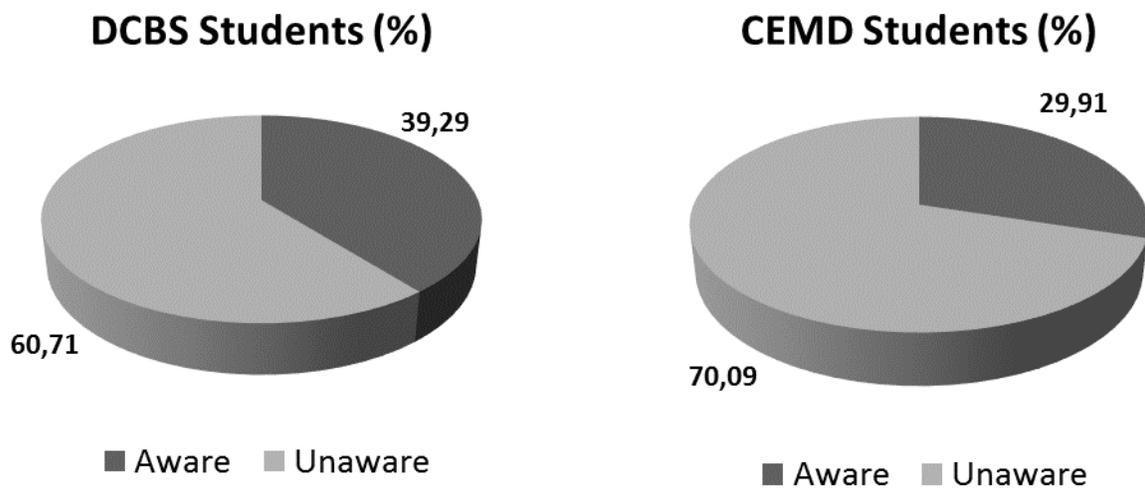
**Figure 3. Awareness of the hazardous substance and waste management program**



Source: Authors' own elaboration.

Most of the students also were unaware of the institutional disposal practices of hazardous materials. Almost 60% the at the DCBS department claimed to be unaware of those practices and almost 70% of the CEMD students claimed so (Figure 4).

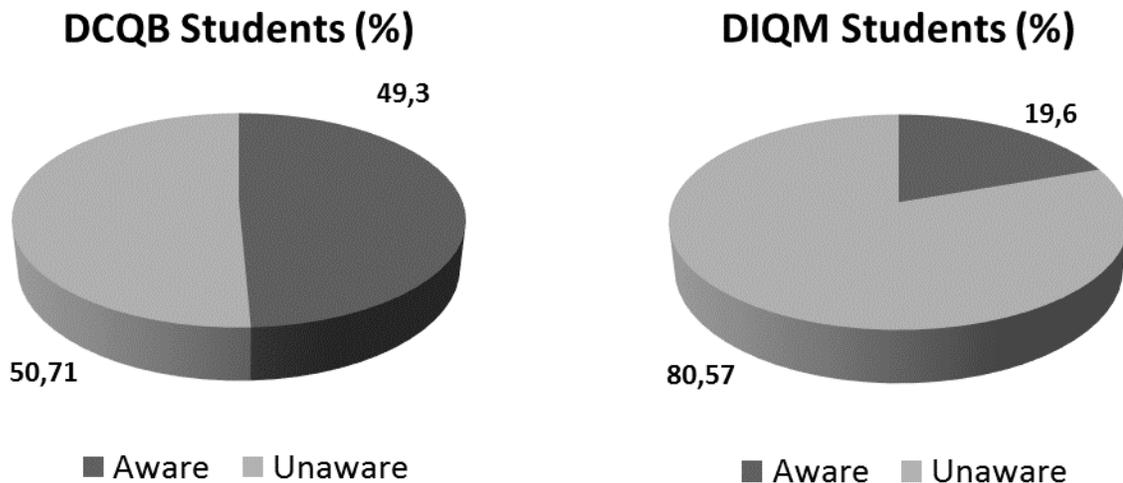
**Figure 4. Awareness of the Disposal Practices**



Source: Authors' own elaboration.

A plurality of students are unaware of the accidents that have happened in the laboratories at the University of Sonora. Very few of the DCBS department students, 49 percent, knew about the occurrence of an accident and less than 20 percentage of students at the CEMD department knew that accidents have happened within laboratories (Figure 5).

**Figure 5. Awareness of the accidents in laboratories**



Source: Authors' own elaboration.

#### 4 Discussion

Since 2004, the University of Sonora has maintained a Sustainability Management System (SMS) in order to harmonize objectives, processes, and resources for protecting the health of users on campus and the environment itself. In 2008, this SMS achieved the certification in ISO 14001 and in 2011 the re-certification ISO 14001. The Hazardous Sustainable Management Program is part of the institutional Environmental Management System (EMS); as a key element of the SMS, an external audit is conducted within all laboratories on campus, which certifies that safety procedures are on place.

As consequence of the ISO 14001 certification, it might be thought that students should be aware of initiatives to increase safety in laboratories because this is usually one of the benefits of implementing this standard (Zeng et al. 2005: 645-656). However, findings on this study show that students are unaware of many safety issues that they should be aware of. Environmental

policy statements are very important in the context of the ISO 14001 standard (Fryxell et al. 2004: 45-57); its relevance is based on that it is a priority for preparing and launching the implemented sustainability initiatives. However, only a small percentage of students reported to be aware of the institutional sustainability policy, which should be a potential concern for the steering committee of the ISO 14001.

At some time, there might be a need to question the necessity to invest for a recertification since EMS implementation around the world reaches saturation eventually (Casadesus et al. 2008: 1741-1754); therefore, it would result more convenient to invest in a hazardous substance awareness program for students and other key players on campus. After discussing actual findings, it is possible theorizing that students could have a false perception about safety in laboratories, which eventually might affect the performance of the institutional environmental management system.

## **5 Concluding remarks**

Having a Sustainability Management System surely has increased safety in chemistry laboratories on the University of Sonora campus; however, it is equally important to raise awareness among students. Despite of being the first university to be ISO 14001 certified in Latin America, most of the students at the University of Sonora are unaware of key topics about the institutional sustainability management system. In particular, students are unaware of internal practices for increasing safety in laboratories. The organization of conferences and workshop are useful to raise awareness among students. A better awareness of the environmental policy and benefits of safety issues among students could be a positive indicator of the relevance of the SMS for increasing the safety within laboratories.

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## ***Świadomość studentów co do ryzyka chemicznego w meksykańskim kampusie: studium przypadku Uniwersytetu w Sonorze***

### ***Streszczenie:***

Edukacja na rzecz zrównoważonego rozwoju (EZR) stanowi potężne narzędzie promocji zrównoważonego rozwoju. Dziesięć lat temu ustanowiona przez ONZ Dekada Edukacji na temat Zrównoważonego Rozwoju (ang.: the UN Decade of Education for Sustainable Development – DESD) promowała tę koncepcję, aby wesprzeć tworzenie bardziej zrównoważonej przyszłości. W 2015 roku ONZ ogłosiło Globalny Program Działań na rzecz EZR (ang.: Global Action Programme on ESD – GAP), aby promować EZR na wszystkich poziomach i we wszystkich układach. Uniwersytet w Sonorze w północnozachodnim Meksyku podjął działania mające na celu „zazielenienie” kampusu poprzez System Zarządzania Zrównoważonego Rozwoju (ang.: Sustainability Management System – SMS), oparty na międzynarodowym standardzie ISO 14001. Celem artykułu jest zmierzenie poziomu świadomości studentów co do bezpieczeństwa w laboratoriach chemicznych na Uniwersytecie w Sonorze. Mimo że uniwersytet jako pierwszy w Ameryce Łacińskiej uzyskał certyfikat ISO 14001, wyniki badań wykazały, że większość studentów Uniwersytetu w Sonorze jest nieświadomych podstawowych kwestii związanych z instytucjonalnym Systemem Zarządzania Zrównoważonego Rozwoju. W szczególności studenci są nieświadomi wewnętrznych procedur mających na celu zwiększenie poziomu bezpieczeństwa w laboratoriach. Większa świadomość studentów co do polityki środowiskowej oraz korzyści wynikających z kwestii bezpieczeństwa mogłaby stanowić pozytywny wskaźnik znaczenia i powiązania pomiędzy Systemem Zarządzania Zrównoważonego Rozwoju a wzrostem poziomu bezpieczeństwa w laboratoriach.

***Słowa kluczowe:*** zrównoważony rozwój, świadomość, postrzeganie, ISO 14001, studenci

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