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# Safety Culture in Higher Education Institutions: Knowledge and Training preferences

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## Abstract

The development of a positive culture is a key element within an organization to achieve performance against a strategic objective. In terms of safety, universities play a very important role in training new professionals who must be increasingly aware and prepared for the challenges of the labour market and daily activities. Therefore, this study aims to assess the safety culture of newcomer students to higher education through the application of a 22-item questionnaire. Participants included 109 undergraduate and master's students from 31 different courses at a university in Northern Portugal. It was observed that the level of knowledge varied according to the type of course adopted and the gender of the student. A global performance level of below 80% shows that safety knowledge can improve further. Additionally, different preferences concerning the content, moment, and format of safety training were presented. The low level of interest in training related to chemical leakage, suspicious package, and bombing show participants may attribute a low probability level to these events. In conclusion, this work shows that it can be useful for universities to consider different training approaches according to different course types.

**Keywords:** Safety Culture; Higher Education Institutions; Safety Education; Emergency; Portugal

## 1 Introduction

Safety culture concerns the way people act, think and behave in relation to safety (Jeffcott et al., 2006). Basically, it is created and disseminated within an organization through the policies, practices and procedures adopted by it. How these measures are put in place and their alignment with organizational objectives will determine the impact of safety culture on overall performance. In this sense, the development of a positive safety culture plays a key role in any organization.

As a complex, multi-, and inter-disciplinary aspect, safety culture can be approached in different manners. In the academic environment, it has been studied from various perspectives, such as Emergency Situations (Hasan & Younos, 2020), Road Safety (Hasan & Younos, 2020), First Aid (Jamaludin et al., 2018), Laboratory Safety (Kou et al., 2021), Patient Safety (Çiftcioğlu et al., 2022; Lee et al., 2018), among others. Assessing the safety culture in educational institutions is key to determining their level of preparedness and reasoning when facing safety-related situations.

Examples of studies focused on safety culture in higher education institutions include Gong (2019), Zhao et al. (2022), and Gao et al. (2022) who investigated the level of safety culture of students at Chinese universities, and Hasan & Younos (2020) who investigated the level of safety culture amongst Bengali students. Other authors that investigated safety culture in universities were Nor Kamilah et al. (2019) in Malaysia, Khalid et al. (2022) in the United Arab Emirates, and Lavasani & Khandan (2021) in Turkey.

In Portugal, only the studies of Inácio (2010), Silva (2016), and Mota (2019) addressed the safety culture in educational institutions. However, none of them investigated higher education institutions. For example, Inácio

(2010) and Silva (2016) dedicated themselves to evaluating the safety culture of primary-level students (i.e., 1<sup>st</sup> to 9<sup>th</sup> school years), while Mota (2019) focused on secondary-level students (i.e., 10<sup>th</sup>, 11<sup>th</sup> and 12<sup>th</sup> school years).

Based on the importance of safety culture in academic environments and the lack of studies in Portugal's higher-level education, the current study evaluated the background, knowledge and preferences of 109 students in relation to emergency situations. This was done through a 22-question questionnaire, which assessed the level of safety culture among 1-year undergraduate and master's students in a Portuguese university.

## 2 Material and Methods

Based on the proposed research objective of investigating the level of safety culture in a Portuguese high-education institution concerning emergency situations, the present study employed an online questionnaire aimed at first-year undergraduate and master's students from the University of Minho (UM) in Portugal. UM has approximately 19,000 students divided between undergraduate, integrated and isolated masters and doctoral students. It has approximately 43 undergraduate courses and 18 integrated masters, which are distributed across three campuses in Northern Portugal (UMinho, 2023).

### 2.1 Sample size

The sample size was established according to the total number of first-year undergraduate and integrated master's students at UM of approximately 3000 students. As Israel (1992) proposed, the sample size was calculated through Equation 1.

$$n_o = \frac{Z^2 p * q}{e^2} \quad \text{Equation 1}$$

Where  $Z$  is the abscissa of the normal curve that cuts off an area  $\alpha$  at the tails ( $1 - \alpha$  equals the desired confidence level, e.g., 90%);  $p$  is the estimate proportion of an attribute that is present in the population;  $q$  is equal to  $1 - p$ ; and  $e$  is the level of precision (e.g., 10%).

### 2.2 Questionnaire development

A 22-item questionnaire was developed to determine the level of knowledge, attitudes and behaviour of students concerning emergency situations. The survey, which was developed only in Portuguese, was prepared and structured on the Google Forms online platform. The questionnaire development was based on literature review studies (e.g., Hasan & Younos (2020), Gao et al. (2022), and Inácio (2010)) and also took into account experts' opinions (professors and safety professionals). The questionnaire validation process consisted of two iterative steps. First, professors and health and safety professionals helped to check the relevance of the questions. Second, four students responded to the questionnaire to verify if it was adapted to the reality of the respondents. After three versions, the questionnaire reached its final version with 22 questions and an average response time of 5 minutes. The questionnaire was composed of four parts, namely, Part I – Socioeconomic aspects (4 questions), Part II – Background (5 questions), Part III - Safety Knowledge (9 questions), and Part IV - Expectations regarding emergency situations (4 questions).

## 2.3 Data Collection

The questionnaire was disseminated by sending an email to the general directory of students, where all UM students, regardless of their level of study (undergraduate, master's or doctorate) were notified. The data collection period was carried out from February 19 to April 12, 2019. A total of 226 students answered the questionnaire. Each student that agreed to participate in this study did so voluntarily after being informed about the research purpose, methods, and the anonymity of obtained data before responding to the questionnaire.

The eligibility criteria used in this study were (1) participants had to be over 18 years old, and (2) participants should be students attending the 1st year of undergraduate degrees or integrated masters. The objective of selecting only first-year undergraduate or integrated master's students was due to the composition of the primary and secondary education national curriculum. In Portugal, primary education students receive training and take safety-related courses. Therefore, to capture the level of student safety culture acquired throughout this education process, only students who had recently entered in higher education were selected. Therefore, after applying the eligibility criteria, 109 answers were included in the final analysis.

## 2.4 Data Analysis

All data collected was exported to, stored, and analysed in Microsoft Excel 2016. The data analysis process was performed using both SPSS Statistics software, version 25 (SPSS Inc., Chicago, IL, USA) and Excel 2016 (Microsoft®). For simplification purposes, participating courses were grouped into three categories, as shown in Table 1.

Table 1 - Courses' categorization.

Category	Participants' courses	Number of courses
Biological Sciences	Degree Applied Biology; Degree in Biology and Geology; Degree in Nursing; Integrated master's in Medicine.	4
Exact Sciences	Degree in Biochemistry; Degree in Computer Science; Degree in Product Design; Degree in Applied Statistics; Integrated Master in Civil Engineering; Integrated Master in Materials Engineering; Integrated Master in Polymer Engineering; Integrated Master in Information Systems Engineering and Management; Integrated Master in Industrial Engineering and Management; Integrated Master in Industrial Electronics and Computers Engineering; Integrated Master in Computer Engineering; Integrated Master in Mechanical Engineering.	12
Human Sciences	Degree in Public Administration; Degree in Political Science; Degree in Communication Sciences; Degree in Criminology and Criminal Justice; Law degree; Degree in Economics; Degree in Education; Degree in Cultural Studies; Degree in Geography and Planning; Degree in management; Degree in Applied Languages; Degree in European Languages and Literature; Degree in Marketing - Post-Work; Degree in International Relations; Integrated master's in psychology.	15

### 3 Results

The final participants' sample of 109 refers to a confidence level of 90% and a level of precision of 10% assuming the total population 3,000 students. The final sample is above the minimum sample size of 97 obtained through Equation 1 for the aforementioned confidence level and precision.

#### 3.1 Socio-demographic

Considering the 109 subjects participating in the sample, 56 were male (51.4%) and 53 were female (48.6%), with an average male age of  $19.3 \pm 2.9$  years old and an average female age of  $21.3 \pm 5.7$  years old. About the composition of the students sample, 93.5% were Portuguese students and 6.5% were foreign students. Fifty-seven per cent of foreign students consisted of Brazilian nationals followed by Cape Verdeans (14.3%), Russians (14.3%) and Ukrainians (14.3%). With respect to the district of origin, among Portuguese students 60.8% were from Braga District, 17.6% from Porto, 11.8% from Viana do Castelo, 2.0% from Leiria and Vila Real, and 1.0% from Guarda and Aveiro.

#### 3.2 Background

In relation to students' academic background, from the 109 subjects participating in the sample, 57.8% (n=63) were taking courses in the field of Exact Sciences, 33.0% (n=36) in Human Sciences, and 9.2% (n=10) in Biological Sciences. In total, 31 courses participated in this study.

Concerning work experience, 50.9% (n=27) of females and 33.9% (n=19) of males performed some type of remunerated activity (e.g., job or internship). Of the 46 students that affirmed having any type of work experience, 17 stated they have received some type of training related to safety.

#### 3.3 Safety Knowledge

Within Part III of the questionnaire, a total of 9 questions were used to determine students' knowledge of safety. Performance was established based on the number of correct answers from each participant in relation to the section's total (i.e., 9 questions). Table 2 shows these results aggregated by course and gender.

Table 2 - Safety Knowledge Performance levels according to course and gender.

Category/Gender	Safety Knowledge Performance
<b>Biological Sciences (n=10)</b>	<b>88.9%</b>
<i>Female (n = 6)</i>	<i>81.5%</i>
<i>Male (n = 4)</i>	<i>100.0%</i>
<b>Exact Sciences (n=63)</b>	<b>79.0%</b>
<i>Female (n = 24)</i>	<i>83.8%</i>
<i>Male (n = 39)</i>	<i>76.1%</i>
<b>Human Sciences (n=36)</b>	<b>74.7%</b>
<i>Female (n = 23)</i>	<i>75.8%</i>
<i>Male (n = 13)</i>	<i>72.6%</i>
<b>Female (n=53)</b>	<b>80.1%</b>
<b>Male (n=56)</b>	<b>77.0%</b>

Women presented a global performance of 80.1% whilst men 77.0%. Participants from Biological Sciences had the best performance amongst all categories (88.9%), followed by Exact Sciences (79.0%) and Human Sciences (74.7%).

### 3.4 Safety training

Part IV of the questionnaire, consisting of 4 questions, sought to understand the student's training interests in relation to safety. In general, the topic that most aroused the students' interest was "gas leakage" (n=107 or 98.2%), followed by "violence" (n=96 or 88.1%), "personal accidents" (n=91 or 83.5%), "evacuation" (n=89 or 81.6%), "fire" (n=88 or 80.7%), "bomb threat" (n=85 or 77.9%), "suspicious package" (n= 76 or 72.5%) and "leakage of chemicals" (n= 74 or 67.9%). It is worth mentioning that the respondents had access to the definition of each one of these categories.

The level of interest in Safety training was also observed through the effect of the course category (i.e., Biological Sciences, Exact Sciences and Human Sciences). It was observed that the participants in the Biological Sciences category were the ones who showed the highest level of interest across all training (87.5%), except for Evacuation, followed by Exact Sciences with 78.8%, and Human Sciences with 78.1%. This can be seen in Figure 1, where it is presented the percentage of participants that showed interest in participating in different training by category.

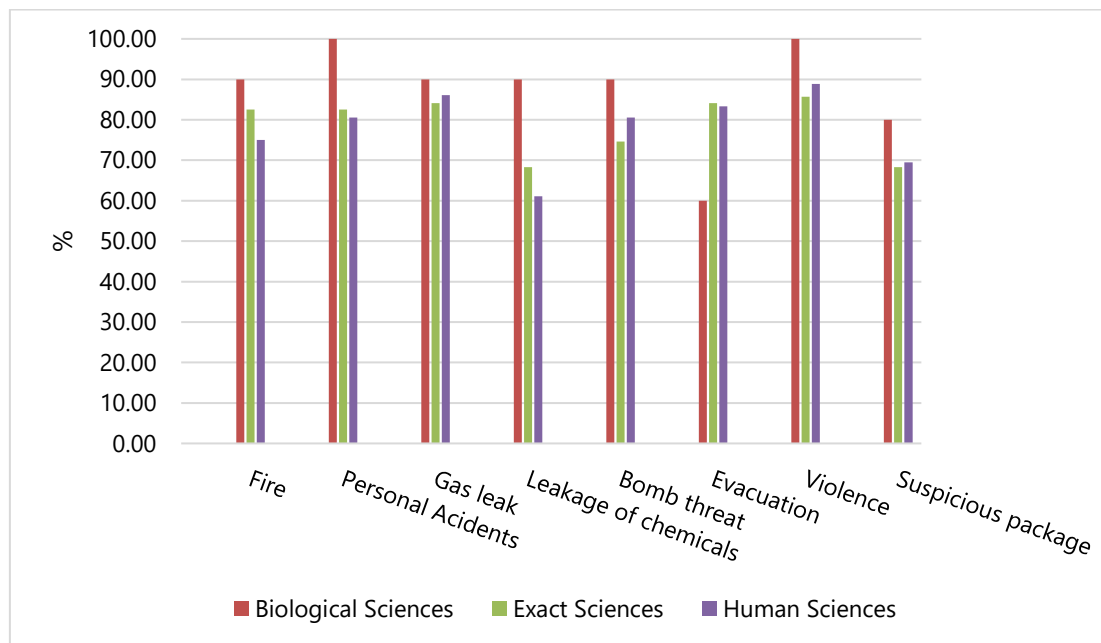


Figure 1 – Preferences concerning the training content by course category.

In question 19, students were asked about the most relevant moment for learning the topic. In general, students had the propensity to choose "Annually" (45.0%) and "At the beginning of the course" (45.0%) as the most relevant moments to learning the emergency subject. In view of the effect of gender, it was not observed differences between the choice of the most relevant moment when comparing males and females, being both divided within "Annually" (male: 44.6%, female: 45.3%) or "At the beginning of the course" (male: 42.9%, female: 47.2%).

However, when considering the effect of the course category, it was observed that was an inclination of Biological and Exact Sciences to choose "At the beginning of the course" as the most relevant moment, while

Human Sciences preferred "Annually". Table 3 shows these results aggregated by course, gender, and moment of training.

Table 3 – Preferences concerning the moment of safety training by course category and gender.

Category/Gender	Moment of training				
	Annually	At the end of course	At the beginning of the course	In the middle of the course	Null
<b>Biological Sciences (n=10)</b>	<b>40.0%</b>	<b>0%</b>	<b>60.0%</b>	<b>0%</b>	<b>0%</b>
Female (n = 6)	16.7%	0%	83.3%	0%	0%
Male (n = 4)	75.0%	0%	25.0%	0%	0%
<b>Exact Sciences (n=63)</b>	<b>44.4%</b>	<b>1.6%</b>	<b>47.6%</b>	<b>4.8%</b>	<b>1.6%</b>
Female (n = 24)	41.7%	0%	50.0%	4.2%	4.2%
Male (n = 39)	46.2%	2.6%	46.2%	5.1%	0%
<b>Human Sciences (n=36)</b>	<b>47.2%</b>	<b>0%</b>	<b>36.1%</b>	<b>11.1%</b>	<b>5.6%</b>
Female (n = 23)	56.5%	0%	34.8%	8.7%	0%
Male (n = 13)	30.8%	0%	38.5%	15.4%	15.4%
<b>Female (n=53)</b>	<b>45.3%</b>	<b>0.0%</b>	<b>47.2%</b>	<b>5.7%</b>	<b>1.9%</b>
<b>Male (n=56)</b>	<b>44.6%</b>	<b>1.8%</b>	<b>42.9%</b>	<b>7.1%</b>	<b>3.6%</b>

As for the preferences of the students in relation to the most propitious arrangement to receive the formation, most of the students preferred workshop (n=37.6%), followed by short-term seminar (n=22.0%), curricular units (n=19.3%), extracurricular units (n=11.9%) and, lastly, optional curricular units (n=7.3%). The "workshop" was described as having both theoretical and practical components with a duration lesser than 2 days. The "seminar" was described as having a duration lesser than 1 day.

Regarding the course category, it was observed that there was an inclination of Biological (n=70%), Exact (n=31.7%) and Human Sciences (n=38,9%) to choose the "workshop" format as the best learning arrangement. The second most chosen option was the "curricular unit" to Biological (n=30%) and Human Sciences (n=25%), while Exact Sciences preferred "short-term seminars" (n=27%). With reference to the effect of gender on choice, it was noticed that was a preference for both, males and females to choose "workshop" as the best format. Table 4 shows these results aggregated by course, gender, and format of training.

Table 4 – Preferences concerning the format of safety training in relation to course category and gender.

Category/Gender	Training format					
	Short-term seminar	Extracurricular Units	Optional Curricular Units	Curricular Units	Workshop	Blank
<b>Biological Sciences (n=10)</b>	<b>0%</b>	<b>0%</b>	<b>0%</b>	<b>30.0%</b>	<b>70.0%</b>	<b>0%</b>
Female (n = 6)	0%	0%	0%	50%	50%	0%
Male (n = 4)	0%	0%	0%	0%	100%	0%
<b>Exact Sciences (n=63)</b>	<b>27.0%</b>	<b>15.9%</b>	<b>9.5%</b>	<b>14.3%</b>	<b>31.7%</b>	<b>1.6%</b>
Female (n = 24)	33.3%	12.5%	8.3%	16.7%	25%	4.1%
Male (n = 39)	23.1%	18.0%	10.3%	12.82%	35.9%	0%
<b>Human Sciences (n=36)</b>	<b>19.4%</b>	<b>8.3%</b>	<b>5.6%</b>	<b>25.0%</b>	<b>38.9%</b>	<b>2.8%</b>
Female (n = 23)	30.4%	4.3%	8.7%	21.7%	34.8%	0%
Male (n = 13)	0%	15.4%	0%	30.8%	46.2%	7.7%
<b>Female (n=53)</b>	<b>16.1%</b>	<b>16.1%</b>	<b>7.1%</b>	<b>16.1%</b>	<b>42.9%</b>	<b>1.8%</b>
<b>Male (n=56)</b>	<b>28.3%</b>	<b>7.5%</b>	<b>7.5%</b>	<b>22.6%</b>	<b>32.1%</b>	<b>1.9%</b>

## 4 Discussion

In general, women presented higher safety knowledge scores than men (80.1% v. 77.0%, Table 2). This relationship was also observed in other studies, such as Al-Surimi et al. (2018), Çiftcioğlu et al. (2022) and Gao et al. (2022). However, this behavior was not observed in Lavasani & Khandan (2021), where authors did not notice any differences between males' and females' safety knowledge. Particularly, Human Sciences presented the lowest safety knowledge performance (74.7%), which indicates a gap of 14 percentage points in relation to the best performance (Biological Sciences, 88.9%). This points out to the necessity of levelling safety knowledge across different fields of study. Moreover, a global performance below 80% shows that safety knowledge can improve further as students advance their studies within the university.

With respect to the preferences of the students (Figure 1), Biological Sciences was the course category that showed the greatest interest in all safety training topics, except for "Evacuation". This may be related to the background of the students, since the courses in this category (Table 1) are courses that work directly with people or animals (e.g., nursing or medicine). Another reason may be the type of course adopted in secondary education, which, depending on the choice, restricts or emphasizes a certain curriculum.

In the case of Exact Sciences, students showed a very low level of interest in the "Leakage of chemicals", "Bomb threat", and "Suspicious package" (Figure 1). The low level of interest in the "Leakage of chemicals" training may be related to the fact that throughout secondary education students have already exhausted the subject. In the case of "Bomb threat" and "Suspicious package", the low level of interest may be related to the fact that students have never witnessed or experienced any situation involving such components, which results in a lower collective perception of its danger and the attribution of a lower event probability. This would be probably different in a country that is a victim of a terrorist attack, for instance, as shown by Nilsen et al. (2018). For Human Sciences, students also showed a low level of interest in the "Leakage of chemicals" and the "Suspicious package". As in the case of Exact Sciences, the reason for this may be related to the fact that students have never witnessed or experienced a similar situation.

## 5 Conclusion

This study included 109 participants from a university located in Northern Portugal, encompassing a student population from 31 different courses. The participants' sample represented well the university 1st-year undergraduate and 1st-year integrated master's population ( $n=109$  in current study v.  $N=3000$  in the university; confidence level = 90% and level of precision = 10%). A 22-question questionnaire evaluated the background, knowledge, and preferences of 1-year students to assess the safety culture of newcomers in higher education in terms of emergency situations.

This was motivated by the lack of studies in the area, as well as the importance of safety-aware professionals in the labour market and day-to-day activities at educational institutions. It was observed that the level of knowledge varied due to the type of course and the student's gender. Safety knowledge can improve significantly as students advance their academic life. Likewise, students from different fields of study presented different preferences concerning the content, moment and format of safety training. This points to one of the main implications of this work related to the consideration of different training approaches according to different types of courses and the investment in further safety training.

As to limitations, this study focused only on the aspect related to emergencies, leaving aside important topics such as traffic safety, first aid, etc. Another limitation of this work was the sample population, which, although not small, could have benefited from better statistical robustness. As a proposal for future work, the safety

culture could be analyzed from the point of view of the whole organization, evaluating the safety culture of teachers, laboratory technicians and other functions involved in the academic environment in relation to the practices, policies and procedures in terms of safety adopted by the educational institution. This would provide a measure of the safety preparedness of the whole organization and identify points for improvement.

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