

Assessing the Level of Safety Measures in University Classrooms: A Case Study in a University in the Southwest of Iran

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Abstract

Background: The classroom is an important part of the educational environment, which should meet the standard requirements including safety and adequate spaces regarding the number of learners, color, lighting, noise, proper equipment, and air conditioning. This study aimed to investigate the safety level of classrooms in Shiraz University of Medical Sciences.

Methods: This cross-sectional study was conducted in Shiraz University of Medical Sciences (SUMS) classrooms (n=63), in the south-west of Iran. Data regarding the safety measures were collected using an audit checklist. Finally, an index called Classroom Safety Requirement Index (CSRI) was introduced in order to calculate percentage of safety measures in the classrooms.

Results: The results revealed that the 'environmental condition' dimension of the CSRI was in a good level. The 'building', 'equipment' and 'electrical' dimensions were in the medium level, and the 'fire safety and emergency' dimension was placed in the poor level. 38.70% of the classes (24 classes) were in the Standard Occupant Load (SOL or degree of overcrowding) and others (61.30% of classrooms) were overcrowded (unacceptable occupant load).

Conclusion: The examined classrooms were very poor regarding the 'fire safety' and 'emergency exit', which requires proper and appropriate measures to improve safety in these areas.

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Introduction

University has a high visibility within societies and plays a key role in the countries' improvement.¹⁻³ In this educational environment which can be considered as a workplace, various activities such as teaching, learning, and researching are performed. Based on the literatures, there are numerous potential hazards and related risks within university environments.^{1, 4} Therefore, universities can be threatened by different sources of hazards similar to other industries and organizations. Some hazardous events have occurred in universities, especially in laboratories. According to a report by the U.S. Chemical Safety and Hazard Investigation Board

(CSB), approximately 120 university laboratory incidents occurred from 2001 to 2011. Laboratory incidents were responsible for 49 fatalities in the U.S.⁵ Moreover, Washington State University (WSU) reported that nearly 40 fatal accidents occurred in the U.S universities due to falls from windows, balconies, decks, and elevated surfaces in the residence halls.⁶

A large population, including faculties, students and staff spend a lot of their daily time at universities. Therefore, providing safety for universities is high priority.⁷ Classroom is an important part of the educational environment, where a teacher works and students acquire skills and knowledge and prepare

for higher education.⁷ This educational environment is the most important element in teaching or learning processes.⁸

Students in the classroom have to spend lots of time in listening and understanding the lessons, remaining sitting at their desk and performing several other activities such as discussing, and writing to a certain extent. They are simultaneously interacting with all elements in a physical environment without knowing these circumstances may contribute to their performances, safety, and health.⁸

It is specified that the unsafe school buildings may adversely affect the students, teachers, administrative and cleaning workers, and visitors.⁹ Therefore, the classrooms must be properly designed to fulfill safety requirements regarding the building, equipment, and environmental factors (e.g. lighting, noise, temperature, humidity).⁸ Classroom safety management focuses on controlling the accident promoting factors within this educational setting.¹⁰ In addition, as Holley and Steiner (2005) noted, a safe classroom space can be viewed as an arena in which students can develop and refine knowledge, attitudes, and skills necessary for culturally competent practice.¹¹

Neshat et al. reported that 88.7% of the schools under the study had not good safety conditions and their main problem was the emergency exit door.¹² In another study, Sosnowska and Kostka stated that 25.2% of accidents took place in the school's corridors and stairs.¹³

In Iran, facilities are not considered for emergency exit in many classrooms. In this condition, it is not possible to evacuate the students during emergency situations, such as earthquakes and fires; then, it may increase the number of casualties.¹⁴ In recent years, in Iran, several accidents have occurred due to unsafe classrooms; this has led to burn and death of a number of students.¹⁵

As mentioned above, safety is a priority within universities, and hazards and their risk should be correctly recognized, evaluated, and controlled.⁵ Risk assessment and hazard identification are important tools in safety management systems, and play a critical role in accident prevention and mitigation. This study was conducted to investigate the safety measures provided for classrooms in Shiraz University of Medical Sciences (SUMS).

Materials and Methods

Study Design

In this cross-sectional study, the safety measures provided in the SUMS classrooms (n=63) were investigated using an audit checklist constructed regarding the safety of classrooms based on national

standards and regulations.¹⁶ In this study, all classrooms in ten schools at the SUMS (School of Medicine, School of Dentistry, School of Pharmacy, School of Health, School of Rehabilitation Sciences, School of Nursing and Midwifery, School of Nutrition and Food Sciences, School of Paramedical Sciences, School of Management and Medical Information Sciences, and School of Advanced Medical Sciences and Technologies) were investigated. Areas of the studied classrooms ranged from 20 to 132 m² (mean±standard deviation: 52.06±25.72 m²).

Safety measures

Required data regarding the safety measures in each classroom were collected using the constructed audit checklist. The checklist consisted of six dimensions including 'building safety' (39 items about dimension of indoor spaces, doors, windows, ceiling, floor, and walls), 'equipment and facilities safety' (31 items about equipment layout, chairs, whiteboard, screen, and projector), 'environmental safety' (11 items about noise, ventilation, and lighting), 'fire safety and emergency evacuation' (10 items about emergency exits, and fire extinguishers), and 'electrical safety' (6 items about earthing system, and electrical wiring and cables) (Table 1).

Items of the checklist were rated on a four-point scale including: 0 (full compliance), 1 (relatively full compliance), 2 (incomplete compliance), and 3 (non-compliance). Non-applicable items were not scored and removed from the checklist.

Finally, an index called Classroom Safety Requirement Index (CSRI) was introduced in order to calculate the percentage of safety measures provided in the classrooms, as follows:

$$CSRI = \frac{\sum x}{3n} \times 100$$

Where: 'n'=number of applicable items, and '∑x'=total points of the checklist

The CSRI was graded on a quarter scale (≤25%: very poor, 26-50%: poor, 51-75%: moderate, and >75%: good). This categorical classification was applied for evaluating the safety levels of classrooms. The same index (Safety Requirement Index (SRI)) was also used successfully by authors in other previous studies to determine the percentage of safety measures provided.¹⁷

The degree of overcrowding of classrooms was calculated by subtraction of the existing occupant load (number of chairs in each classroom) from a Standard Occupant Load (SOL). A negative value of this index shows that the number of students in the class is higher than SOL.

Degree of overcrowding (SOL) of a classroom

Table 1: Safety dimensions of the study classrooms

Dimension		Number of item	Description
Building safety	Indoor space	6	Indoor spaces, and dimensions of classrooms (e.g., doors, windows, floor, and walls)
	Doors	10	
	Windows	15	
	Ceiling , floor , wall	8	
Equipment and facilities safety	Layout	9	Chairs and whiteboard layout, number of chairs, ergonomic assessment of the chairs
	Chair	11	
Environmental conditions	Whiteboard, screen and projector	11	Noise, ventilation, lighting
	Noise	3	
	Ventilation	4	
Fire safety and emergency evacuation	Lighting	4	Emergency exits and fire extinguishers
		10	
Electrical safety		6	Earthing system, and electrical wiring and cables

Table 2: General characteristics and safety indices in the study classrooms

Characteristic		No. (%)	
Number of occupants	≥25	1 (1.6)	
	25-49	45 (72.58)	
	50-99	12 (19.35)	
	≥100	4 (6.45)	
Area (m ²)	≤40	17 (27.41)	
	40-79	38 (61.29)	
	≥80	7 (29.11)	
Occupant load	ISIRI	Acceptable (1.25 m ² per person)	24 (38.70)
		Unacceptable (<1.25 m ² per person)	38 (61.29)
	NFPA	Acceptable (1.9 m ² per person)	10 (16.12)
		Unacceptable (<1.9 m ² per person)	52 (83.87)
Characteristic		Mean±SD	
CSRI	Building safety	73.40±5.90	
	Equipment safety	73.92±3.10	
	Environment condition	86.77±7.83	
	Fire safety and emergency response	11.68±11.48	
	Electrical safety	69.74±6.56	
	Overcrowding degree		
	ISIRI	-8.44±11.73	
	NFPA	-10.09±8.39	

CSRI: Classroom Safety Requirement Index, ISIRI: The Institute of Standards and Industrial Research of Iran, NFPA: National Fire Protection Agency

was calculated by dividing the gross floor area of the classroom to Occupant Load Factor (OLF) for educational use; 1.25 m² and 1.9 m² per person according to the Institute of Standards and Industrial Research of Iran (ISIRI 2086)¹⁶ and National Fire Protection Agency (NFPA),¹⁸ respectively.

In all the classrooms studied, the chairs were not fixed, and could be moved by students. Therefore, this situation may play a role as a barrier in emergency situations and traps the students in the classrooms.

Results

Table 2 shows the general characteristic and safety indices of the studied classrooms. According to ISIRI and NFPA standards, respectively, 38 (61.29%) and 52 (83.8%) classrooms had an unacceptable occupant load. The average of CSRI in the studied classrooms was 71.25±25.06% and most of them had moderate safety levels. In addition, the level of safety was good at the

dimensions of ‘environmental conditions’; moderate in the dimensions of buildings, facilities and ‘electrical safety’, and the level of ‘fire safety and emergency evacuation’ was assessed to be poor in the studied classrooms. In addition, the majority of study classrooms had some degrees of overcrowding according to ISIRI and NFPA standards (-8.44±11.73 and -10.09±8.39, respectively).

Figure 1 shows the degree of overcrowding in the studied classrooms. As shown, approximately most of the classrooms had negative degree of overcrowdedness. It means that the number of students in the classes is higher than the SOL.

Discussion

This study was conducted to assess the safety measures provided in SUMS classrooms, the south-west of Iran. The average value of CSRI in all dimensions was calculated to be 63.13±6.95%. Dimensions of

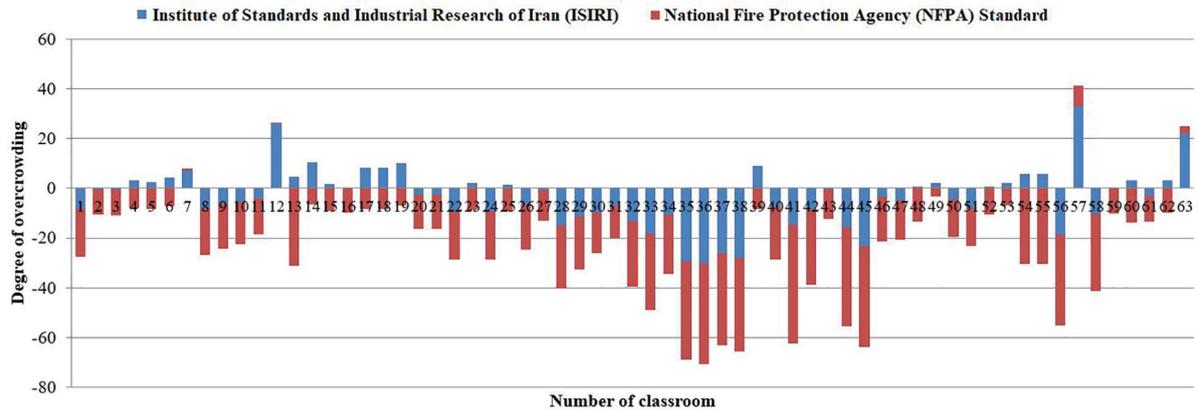


Figure 1: Degree of over-riding in the studied classroom according to the ISIRI and NFPA standard

‘environmental conditions’ (86.77±7.83%) and ‘fire safety and emergency evacuation’ (11.68±11.48%) had the highest and lowest values of CSRI, respectively.

Most of the studied classrooms had unacceptable occupant load and suffered from some degree of overcrowdedness. Overcrowding is a common problem in classrooms which could increase the risk of potential hazards such as slips, trips and falls and impedes the safe evacuation in the event of a fire.¹⁹ Therefore, it is reasonable to keep the number of students in the classroom in the allowable range and also provide and maintain the means of access to and egress for safe and risk-free evacuation. Overcrowding prevents the safe movement of the individuals in the case of evacuation in the emergency situations. Maximum probable number of persons who will occupy a space must not exceed from occupant load calculated based on the area of the space to the OLF. According to the ISIRI 2086, the OLF for learning space is 1.25 m² per person,¹⁶ but the results of the current study showed that the average rate of overcrowding in the classrooms was -8.44±11.33, and 61.30% (38 classes) of the studied classrooms had an unacceptable occupant load. In this context, in the NFPA standard it has been mentioned that the OLF for learning space is 1.9 m² per person.¹⁸ The results of the present study revealed that the average rate of overcrowding in the classrooms was -10.09±8.39, and 83.27% (52 classes) of the classrooms were in the overcrowded category (unacceptable occupant load). It seems that the best strategy for meeting the SLO is reducing the number of chairs in the classroom to provide the required space for each occupant. In some cases, classrooms were not designed for educational purposes originally. They were changed later to be used as classrooms. Therefore, they did not fully meet the safety standards for educational premises.

In this study, the lowest value of CSRI was related to the dimension of ‘fire safety and emergency evacuation’. The most cases of noncompliance for this dimension were related to lack of emergency

exits, fire extinguishers, exit signs and fire escape plan. To improve the CSRI in this dimension, there is a need to provide the emergency exits or reduce the number of students according to the SOL. Indeed, the management of risk should be considered as an essential component of the strategic planning process in the university.²

Two exits are required for any space being occupied by 49 or more people, and these need to be separated from one another as much as possible.²⁰ Preferably, they should be at opposite sides of a room or, at least, at opposite ends of the same wall. In the current study, classrooms (25.90%) had more than 49 occupants and needed two separate exits, while only 3 classrooms met this standard. In this study, all chairs were not fixed and students were free to change the layout of the chairs, which could lead to locking exit and routes and i delay in emergency evacuation. Therefore, it is recommended that the the chairs should be fixed and we should consider at least 15 ft² of space (3’×5’) for every person present.²¹ This would allow people to move more freely toward the exits if the need arises.

The last but not the least was noncompliance in the emergency response; this dimension was related to exit signs. Exit signs should be clearly visible and lighted over each exit door. In all the studied classroom, there were no emergency signs showing the exit wags in the buildings.

Another requirement for exit doors in the means of the egress is their swing in the direction of egress for areas with an occupant load of 50≥.²⁰ In this study, out of 16 (25.8%) studied classroom with an occupant load of 50 ≥, in three classrooms doors swung in the direction of exit. This requirement is more crucial for crowding classrooms.

Strengths and Limitations

So far, in Iran, no study has been conducted to assess the safety measures provided in university classrooms. This study was conducted in all

classrooms of ten schools at the SUMS. The findings could help the SUMS managers to prioritize safety defects in classrooms, especially in the ‘fire safety and emergency evacuation’ dimension.

Conclusion

In general, the safety measures provided in the studied classrooms were in the moderate level. In addition, the findings showed that the CSRI was unacceptable for ‘fire safety and emergency evacuation’ dimension. Moreover, the majority of the classrooms were overcrowded and had unacceptable occupant loads.

To be more compliant with standards, we need to consider the related requirement for the design of new spaces and maintain the number of students at SOLs, for the existing classrooms.

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