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Identification of safety hazards and risk assessment using the Hazid technique and designing strategic policies in the SWOT matrix

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ABSTRACT

Background and objective: The most important goal of this applied research was the analysis and evaluation of the existing situation parametric indicators of safety at the level of secondary schools in Ahvaz based on the pathology approach diagnosis, planning, Policymaking, and strategic-operational management. Which strategic components are more important in the field of safety risks for Ahvaz secondary schools?
Materials and methods: To determine the current status of safety indicators in Ahvaz schools, the HAZID technique was implemented. The analysis of external and internal factors affecting the status of safety indicators in Ahvaz secondary schools was done using a SWOT matrix.
Results and conclusion: In connection with the safety risks caused by the technical specifications of Ahvaz secondary school's buildings, the occurrence of serious accidents for students while passing through the street has the highest level of risk, and the risk level was equal to 9475/44 and unacceptable. Regarding the safety hazards caused by the characteristics and grounds of Ahvaz secondary schools, the destruction of school buildings due to non-compliance with architectural standards was the highest risk, and the risk level was equal to 2840/37 and unacceptable. Therefore, it can be acknowledged that the present applied research tries to adopt an approach active and preventive; due to the new perspective, the strategy-oriented approach can be of special importance and credibility in the national and international arenas.

1. Introduction

Health is one of the most fundamental human rights and needs, and governments must implement programs to ensure its highest level for all members of society. Among these, students hold particular significance as they represent a vulnerable group and are considered the future builders of society

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(Zaplluzha & Shahini, 2016). Investing in student health by achieving safety goals is economically sound and contributes to increased productivity (McAllister & Flynn, 2016).

A key factor in ensuring student health is the physical environment of schools. If educational facilities and infrastructure do not meet safety and health standards, the efforts of school staff will be less effective. Students are valuable human capital, and any risk or accident affecting them can have significant consequences (Bicalho et al., 2021). Surveys conducted in schools across the country highlight numerous safety deficiencies, including building location, structural integrity, electrical systems, heating installations, and even factors like wall colors and stair safety. These issues often lead to serious accidents, such as fires, falling debris, or even fatal incidents (Ranasinghe et al., 2020).

Ensuring safety in schools requires strict adherence to safety regulations. In Iran, with approximately 13 million students, there is a growing focus on constructing schools that guarantee both health and safety (Luetz & Sultana, 2019). Thus, building modern, secure schools that can withstand natural disasters like floods, earthquakes, and fires is crucial. Schools should also serve as crisis management centers during such events (Vilaça et al., 2019). The diversity in the quality of school buildings across cities and rural areas makes it essential to improve safety in existing schools, as this enhances the psychological security of both students and their families (Vallinkoski & Koirikivi, 2020).

Reducing disaster risk and providing disaster preparedness training is a global challenge and a shared concern among governments. As a result, many countries have adopted international cooperation to reduce the risk of accidents and disasters, aiming to protect public health and safeguard cultural, environmental, and personal assets. Achieving this requires the collaboration of government institutions and the implementation of comprehensive laws at both national and local levels (Hilbert, 2016). Additionally, the participation of the entire society is essential to meet these safety goals (Yu & Zhu, 2016).

Schools serve as the second home for students, where they spend a significant amount of time after their own homes. The potential for accidents in schools, due to overcrowding, constant movement, and other factors, is often greater than in homes. The statistics on school accidents highlight the seriousness of this issue (Yu, 2015). Therefore, it is imperative to teach safety measures at all levels of education to prevent disasters and mitigate risks. Managing natural disasters and preventing unexpected events are unavoidable tasks, and following safety guidelines in schools can significantly *reduce accidents (Lindfors & Teperi, 2019).*

Unlike traditional safety risk assessment methods that focus on passive, problem-oriented approaches, this research presents a proactive and strategic approach to safety risk management. For the first time in the country, a strategic safety risk management policy was implemented for secondary schools, focusing on macro-level, preventative measures. The study identified the technical characteristics of school buildings as the most critical factor in ensuring safety in secondary schools in Ahvaz. Many of these schools exhibit worrying safety deficiencies, particularly concerning compliance with safety standards and regulations.

The primary objectives of this applied research are to analyze and evaluate the current safety conditions in secondary schools in Ahvaz using the HAZID technique. The research follows a diagnostic, planning, policymaking, and strategic-operational management approach, aiming to address safety deficiencies and propose solutions.

2. Materials and Methods

2.1. Study Area

The study area for this research is Ahvaz, the capital city of Khuzestan province, located in the southwest of Iran. Ahvaz lies between latitudes 31° 19′ N and longitudes 48° 40′ E, with an

altitude of approximately 18 meters above sea level. The city is known for its diverse climate, experiencing extremely hot summers with temperatures often exceeding 50°C and relatively mild winters. Ahvaz is an important industrial and commercial hub due to its proximity to oil-rich regions, making it a center of economic activity.

In terms of education, Ahvaz has a variety of schools, ranging from primary to secondary levels. However, the construction quality and safety standards of these schools vary significantly across different regions. Many schools in Ahvaz, especially in older districts, suffer from infrastructural issues, including outdated buildings, lack of adequate safety features, and insufficient maintenance. This situation is exacerbated by the city's exposure to natural disasters, such as floods, dust storms, and seismic activity, making the safety of schools a critical concern.

In recent years, Ahvaz has witnessed increased urbanization and population growth, which has led to higher student density in schools and, consequently, greater risks associated with overcrowded environments. The diversity of school buildings—ranging from newly constructed, modern facilities to older, more vulnerable structures—poses challenges in terms of ensuring uniform safety standards across the city.

The study focuses on secondary schools within Ahvaz, where students are in their most formative academic years and are more susceptible to risks due to the infrastructure's inadequacies. By evaluating these schools' safety indicators using the HAZID technique, this research aims to identify key vulnerabilities and propose strategic solutions to enhance safety measures. The goal is to create a safer learning environment for students and ensure that schools can function effectively even in the event of natural disasters.

2.2. Strategic Evaluation and Scenario Planning for Safety Management in Ahvaz Secondary Schools Using HAZID Technique

In this research, relevant statistics, documents, and technical reports were first gathered to provide the necessary foundation. The current status of safety indicators in secondary schools in Ahvaz was then analyzed. To evaluate these safety indicators, the Hazid technique methodology and algorithm were applied.

Strategic issues, as well as internal and external factors influencing the safety indicators in Ahvaz's secondary schools, were extracted based on three types of questionnaires: 1) building technical specifications, 2) the condition of the school grounds, and 3) characteristics of school spaces. These factors were then analyzed using the SWOT matrix. Through this process, the key strategic factors and parameters were identified for decision-making, planning, policy-making, and strategically managing school safety. These factors were categorized into three levels: strategic components, criteria, and sub-criteria.

In the next stage, by focusing on the most critical strategic safety issues, both macro and micro objectives were defined. A strategic scenario planning approach was employed to design a comprehensive set of strategies for managing school safety risks and hazards. The process is illustrated in Fig. 1.

Fig. 1 Flowchart of the study stages

2.3. Hazard Identification

Hazard Identification (HAZID) is a practical tool used for identifying and quickly describing various risks and threats to people, public spaces, and workplaces from an HSE (Health, Safety, and Environment) perspective. Its primary objective is to enable operational planning aimed at minimizing the severity, scope, and recurrence rate of potential incidents. Additionally, it aids in making informed decisions and implementing system optimizations before the execution phase (Kour et al., 2020).

For the implementation of this project, an expert and experienced team was employed. The methodological process was designed to achieve the research objectives, beginning with the collection and analysis of necessary statistics, documents, and technical reports. The current status of safety indicators in secondary schools in Ahvaz was thoroughly analyzed. This research applied the HAZID technique to objectively assess safety hazards in these schools.

The analysis involved completing and reviewing three types of questionnaires and checklists, identifying different types of safety hazards, the factors generating them, and the locations where these hazards were most likely to occur. Table 1 provides an overview of the types of safety hazards

identified, while Tables 2–4 offer detailed insights derived from brainstorming sessions and the collected data (Kim et al., 2015).

Table 1- Identification of the safety hazards of Ahvaz secondary schools based on the outputs analysis of three types of questionnaires

Types of safety hazards in Ahvaz secondary schools	Factors generating safety hazards in Ahvaz secondary schools	Types of safety hazards centers in Ahvaz secondary schools

In the continuation of the implementation of the methodological process; the HAZID risk assessment and identification sheet for Ahvaz secondary schools have been completed.

Table 2- HAZID risk identification and assessment worksheet in Ahvaz secondary schools based on the condition of school grounds

Required controls	Risk number	Exposure	Severity of consequence	Probability of occurrence	Hazards

Table 3- HAZID risk identification and assessment worksheet in Ahvaz secondary schools based on characteristics of school space

Required controls	Risk number	Exposure	Severity of consequence	Probability of occurrence	Hazards

Table 4-HAZID risk identification and assessment worksheet in Ahvaz secondary schools based on technical specifications of school buildings

Required controls	Risk number	Exposure	Severity of consequence	Probability of occurrence	Hazards

2.4. Risk assessment

With the help of the matrix of three variables, the worksheets were completed according to the severity of consequence, exposure, and probability of the occurrence of risks, and the risks according to Table 5 were divided into unacceptable, undesirable, and acceptable. Risks based on the prioritization are shown in Table 6 (Hesami Arani et al., 2020).

Table 5-Three-variable risk matrix in the HAZID technique

L	Probability of occurrence	E	Exposure	C	Severity of consequence
10	Very probable	10	Continuous	100	Catastrophic
6	Probable	6	Repeated	50	Critical
3	Unusual but possible	3	Sometimes	25	Very serious
1	Unlikely	2	Unrepeatable	15	Serious
0.5	Imaginable	1	Rare	5	Important
1	Practically impossible	0.5	Very rare	1	Partial

Table 6-Classification of the degree of risk

Degree of risk	Risk number
Unacceptable	>600
Undesirable	300-599
Acceptable but needs to be revised	90-299
Minor risks	<90

The most important internal weaknesses the most important internal strengths the most important external opportunities and the most effective external threats in Ahvaz secondary schools were identified from the perspective of safety indicators by SWOT technique. In continuation, leveling of strategic components, criteria, and sub-criteria effective in processes decision-making and policy-making of secondary schools in Ahvaz from the point of view of safety indicators were performed. At next step is focusing on the most important strategic issues in the field of security and micro and macro strategic goals; strategic scenario planning, designing and drawing a range of types of Strategies for facing and dealing with risks and safety hazards for the schools in question. A total of 19 strategies (SO, ST, WO, and WT) were prepared, and finally, for each of the designed strategies, strategic policies have been drawn.

3. Result

3.1. Identification of Safety Hazards in Secondary Schools: A Focus on Structural, Spatial, and Ground Conditions in Ahvaz

The identification of safety hazards in secondary schools in Ahvaz was conducted across three main hazard centers: 1) technical specifications of school buildings, 2) characteristics of school spaces, and 3) the condition of school grounds. The types of hazards identified in each of these centers are presented in Table 7.

Table 7- Identification of the safety hazards in Ahvaz secondary schools in the three hazard centers

Hazards centers	Safety hazards
1- Technical specifications of school buildings	Demolition of the building due to improper concrete processing caused by lack of reinforcement school buildings
	Demolition of the building due to the failure to properly implement the partitions due to the lack of retrofitting of the school building
	Demolition of the building due to lack of accurate calculations of the structure caused by lack of reinforcement
	Demolition of the building due to change of user type caused by failure to retrofit the building schools
	Falling stones and tiles from the façade school buildings from no reconstruction of the building
	The decay of electric wires and the occurrence of fire caused by the lack of reconstruction of school buildings
	Electrocution of unsafe connections and sockets due to the lack of reconstruction of school buildings.
	Inadequate heating and cooling system due to lack of reconstruction of school buildings.
	Catch fire the direct flame heating equipment for the reason of lack of renovation of school buildings
	Inhalation of leaked gas from gas-burning devices and connections due to the lack of reconstruction of school buildings
	Heat loss due to old windows caused by the lack of renovation of the building
	Insulation problems of schools due to old materials caused by lack of renovation of the building
	Occurrence of life risks due to lack of fire alarm system
	Inhalation of produced gases caused by the absence of the system fire extinguishing
	Transmission of pathogens (fungal, infectious, and parasitic) caused by the lack of ventilation appropriate.
	Decreasing the level of air quality inside the classrooms due to the lack of a proper ventilation system
	Reduced visual comfort caused by lack of lighting and exposure
	Occurrence of casualties caused by lack of training of school personnel regarding the way of working with firefighting equipment
	Inability to react in time in the event of accidents due to the lack of aid boxes in schools
1- Technical specifications of school buildings	Failure to treat minor injuries and surface injuries due to the lack of first aid boxes in schools.
	No contact with essential centers (emergency, fire department, etc.) due to the lack of familiarity with the personnel
	Inability to use fire extinguishers due to lack of familiarity of school personnel with how to provide relief

Table 7- Identification of the safety hazards in Ahvaz secondary schools in the three hazard centers

Hazards centers	Safety hazards
1- Technical specifications of school buildings	Inability to assist with minor injuries due to lack of familiarity of school personnel with the aid method.
	Inability to control knowledge students after the earthquake or accidents caused by lack of familiarity with school personnel with manners of relief
	Inability to invite knowledge students to calm down and prevent their dispersion in conditions critical and emergency caused by lack of familiarity with the personnel especially when dealing with the situation critical and emergency
	Not having the right solutions to take shelter of knowledge students in critical situations and emergencies caused by lack of acquaintance of personnel regarding dealing with critical situations and emergencies.
	Failure to execute maneuver operations and Relief and lack of knowledge of students in critical situations and emergencies caused by lack of acquaintance of personnel regarding dealing with critical situations and emergency
	Inability to introduce emergency exit routes in class, laboratory, and yard the school in critical condition and emergency caused by lack acquaintance of personnel regarding dealing with critical situations and emergency
	Directing students to unsafe places due to not specifying and marking the safe point
	Falling from height, windows, and stairs without protection due to the blockage of unsafe ways, stairs, and warehouse
	The possibility of students falling caused by lack of marking and securing absorption and septic wells tanks in schools
	Incidence of severe accidents for students while passing from across the street and death their death the reason of lack of warning signs
2- Characteristics of school space	2-1- Crowd in grounds caused by insufficient per capita area
	2-2- Inappropriate jokes in insufficient per capita area
	2-3- Lack of hygiene caused by inadequacy of proper toilets for students
	2-4- Outbreak of infectious diseases caused by insufficient a toilet suitable for knowledge students.
	2-5- The spread of infectious diseases caused by inadequate sanitary facilities for students.
	2-6- Fracture of the ceramic floor due to lack of quality W.C.
	2-7- Disruption of door handles due to lack of quality W.C.
	2-8- Pelvic fracture caused by lack of service quality sanitary.
	2-9- Lack of proper ventilation due to lack of quality W.C.
	2-10- Destruction of school buildings due to non-compliance with architectural rules caused by failure to comply with the rules of architecture.
	2-11- Increased pollution caused by cars caused by insufficient green space per capita appropriate.

Table 7- Identification of the safety hazards in Ahvaz secondary schools in the three hazard centers

Hazards centers	Safety hazards
3- The condition of the school grounds	2-12- The adverse effect of pollution is the sound of cars caused by inadequacy per capita suitable green space.
	3-1- Slow settlement or tilting of the building caused by not conducting geotechnical tests, before the construction of schools
	3-2- Error in design structure the reason for non-performance geotechnical tests, before the construction of schools
	3-3- Error in determination loading capacity caused by failure to conduct tests geotechnics, before construction schools
	3-4- Destruction of schools during floods caused by the construction of schools in the path of floods and rivers
	3-5- Exposure to electromagnetic fields with ELF frequency as a result of entering the high voltage electric field
	3-6- Throw objects on the grid the reason for the establishment of schools in high voltage electricity
	3-7- User interference and electromagnetic fields the reason for the establishment of schools in the high voltage electricity
	3-8- Occurrence of events for students due to the establishment of schools on the road
	3-9- Severe air pollution in schools is the reason of establishment schools in the vicinity of factories and industries
	3-10- Exposure to noise levels higher than the standard due to the establishment of schools exposed to noise pollution
	3-11- Exposure to fine dust, caused by the establishment of schools in the area of air pollution
3- The condition of the school grounds	3-12- exposed to radon gas taking due to the establishment of schools near cemeteries
	3-13- Incidence of various diseases caused by the establishment of schools in the vicinity of the hospital
	3-14- Occurrence of events for students due to the establishment of schools nearby railways

3.2. Risk Quantification and Prioritization of Hazards in Secondary Schools Using HAZID Technique

With the help of expert reports and risk assessments, the risk numbers for identified hazards were determined, as presented in Table 8. The prioritization of unacceptable and high risks was based on the risk levels obtained through the HAZID technique.

Technical Specifications of School Buildings:

The analysis of safety hazards related to the technical specifications of Ahvaz secondary school buildings (based on the risk levels) shows that:

- 0.59% of risks are acceptable but require revision,
- 0.48% are undesirable risks,
- 1.02% are minor risks, and

- 97.89% fall under unacceptable risks.

The highest level of risk in this category is associated with serious accidents such as student injuries or fatalities while crossing streets due to the lack of safety and warning signs. Similar studies in Malaysian schools also reported high accident rates among students, indicating the significance of such risks (Bicalho et al., 2021). Additionally, risks related to fire incidents in schools are a serious threat, as many schools lack adequate safety conditions. The use of oil-burning heaters and the absence of fire prevention measures exacerbate these risks (Seyedin et al., 2020).

Characteristics of School Space:

In terms of safety hazards related to the physical space of secondary schools, the HAZID results indicate:

- 5.07% of risks are acceptable but need revision,
- 0.48% are undesirable risks,
- 1.09% are minor risks, and
- 90.37% are unacceptable risks.

The most significant hazard in this category is the structural failure of school buildings due to non-compliance with architectural standards, which poses a major threat to student safety. Previous research highlights the importance of proper architectural planning in enhancing student well-being and motivation (Campos, 2020). Additionally, ergonomic, biological, and chemical hazards, along with inadequate sanitary facilities, pose serious risks to students, with the latter identified as having an unacceptable level of risk in our study (Sambasivam et al., 2017).

Condition of School Grounds:

Regarding the condition of school grounds, the HAZID technique results show:

- 0.53% of risks are minor,
- 1.69% are acceptable but need revision, and
- 97.76% are unacceptable risks.

The most critical issue in this category is design errors resulting from the lack of geotechnical testing prior to school construction, which has been assigned the highest level of risk. Similar findings were reported in risk assessments of schools in Italy, where geohydrological risks were significant (Pazzi et al., 2016). In our study, structural design flaws related to the absence of geotechnical testing resulted in a high-risk score of 5680.74, highlighting the serious nature of this threat.

Table 8-Risk prioritization based on the level of risk obtained in the HAZID technique

risk level	Risks of school's space	risk level	Risks of school's ground	risk level	Risks of school buildings
5680.74 (unacceptable)	The occurrence of mistakes in the design of the structure due to the failure to conduct geotechnical tests before the construction of schools	2840.37 (unacceptable)	Destruction of school buildings due to non-compliance with architectural regulations due to non-compliance with architectural regulations	9475.44 (unacceptable)	Occurrence of severe accidents for students while crossing the street and their deaths due to not installing safety and warning signs

Table 8-Risk prioritization based on the level of risk obtained in the HAZID technique

risk level	Risks of school's space	risk level	Risks of school's ground	risk level	Risks of school buildings
5680.74 (unacceptable)	The occurrence of mistakes in determining the loading capacity due to the failure to conduct geotechnical tests before the construction of schools	2170.62 (unacceptable)	The adverse effect of car noise pollution caused by insufficient green space per capita	6814.72 (unacceptable)	Inability to introduce emergency exit routes in the classroom, laboratory, and schoolyard in critical and emergencies due to the lack of familiarity of personnel regarding dealing with critical and emergencies
3409.82 (unacceptable)	Slow settlement or tilting of the building caused by not conducting geotechnical tests, before the construction of schools	2170.62 (unacceptable)	The adverse effect of car noise pollution caused by insufficient green space per capita	6814.72 (unacceptable)	The inability to invite students to calm down and prevent their dispersion in critical and emergencies due to the lack of familiarity of the personnel regarding dealing with critical and emergencies
160 (acceptable)	Exposure to fine dust caused by the establishment of schools in the area of air pollution caused by the penetration of fine dust	1302.37 (unacceptable)	The increase in pollution caused by cars due to insufficient green space per capita	6814.72 (unacceptable)	Not having suitable solutions for sheltering students in critical emergencies due to the lack of familiarity of personnel regarding dealing with critical emergencies
96 (acceptable)	Exposure to radon gas due to the establishment of schools in the vicinity of cemeteries and cemeteries	1280 (unacceptable)	Bowl breakage due to lack of sanitary facilities	6814.72 (unacceptable)	Failure to implement maneuver and relief operations and students' unpreparedness in critical emergencies due to lack of familiarity with personnel regarding dealing with critical emergencies
50.11 (minor risk)	Occurrence of accidents for students due to the establishment of schools in the vicinity of railway lines	768 (unacceptable)	Broken ceramic floor due to poor quality of bathroom	5679.37 (unacceptable)	Occurrence of casualties due to lack of training of school personnel on how to work with fire extinguishing equipment
6.19 (minor risk)	Exposure to electromagnetic fields with ELF frequency as a result of entering the high voltage electric field	768 (unacceptable)	Lack of proper ventilation due to lack of sanitary facilities	4825.07 (unacceptable)	Occurrence of life risks due to lack of fire alarm system
6.19 (minor risk)	Throwing objects on the network due to the establishment of schools in the territory of high-voltage electricity	309.88 (acceptable but needs to be revised)	The spread of infectious diseases caused by insufficient sanitary facilities for students	4745 (unacceptable)	Inability to use fire extinguishers due to lack of familiarity of school personnel with first aid methods
6.19 (minor risk)	User interference and the range of electromagnetic field caused by the establishment of schools in the area of high-voltage electricity	256 (acceptable)	Slipping of students due to lack of sanitary facilities	4089.58 (unacceptable)	Inability to use fire extinguishers due to lack of familiarity of school personnel with first aid methods
5.68 (minor risk)	Destruction of schools during floods caused by the construction of schools in the path of floods and rivers	256 (acceptable)	Disruption of door handles caused by the lack of bathroom quality	3270.61 (unacceptable)	Falling from a height, windows, and staircases without protection due to the blockage of unsafe ways, staircases, and warehouses
2.22 (minor risk)	The incidence of various diseases caused by the establishment of schools in the vicinity of hospitals and	46.43(minor risk)	Non-observance of hygiene due to insufficient sanitary facilities suitable for	3270.61 (unacceptable)	A fire in the school warehouse was caused by the blocking of unsafe roads, stairs, and warehouse

Table 8-Risk prioritization based on the level of risk obtained in the HAZID technique

risk level	Risks of school's space	risk level	Risks of school's ground	risk level	Risks of school buildings
	clinics		students		
1.85 (minor risk)	Occurrence of accidents for students due to the establishment of schools on the road	32(minor risk)	Inappropriate jokes on the campus due to the insufficiency of the campus per capita	1024 (unacceptable)	Destruction of school buildings with masonry frames during an earthquake
1.60(minor risk)	Exposure to noise levels higher than the standard due to the establishment of schools exposed to noise pollution	32(minor risk)	Overcrowding in the area due to the inadequacy of the area per capita	327.68 (undesirable)	Destruction of school buildings with masonry frames during an earthquake
1.54 (minor risk)	Severe air pollution of schools due to the establishment of schools in the vicinity of factories and industries			204.25 (acceptable but needs to be revised)	Inhalation of gases produced due to the absence of a fire extinguishing system
				204.25 (acceptable but need to be revised)	Inability to assist with minor injuries due to the lack of familiarity of school personnel with the aid method
				80 (minor risk)	Lack of contact with essential centers (emergency, fire department, etc.) due to lack of familiarity of school personnel with the method of providing aid
				80 (minor risk)	Inadequate heating and cooling system due to lack of reconstruction of school buildings
				80 (minor risk)	The fire of direct flame heating appliances caused by the lack of reconstruction of school buildings
				80 (minor risk)	Inhalation of leaked gas from gas-burning devices and connections due to the lack of reconstruction of school buildings
				80 (minor risk)	Falling stones and tiles from the facade of the school building due to the lack of reconstruction of the building
				80 (minor risk)	The decay of electric wires and the occurrence of fire caused by the lack of reconstruction of school buildings
				49.62 (minor risk)	Electrocution of unsafe connections and sockets due to the lack of reconstruction of school buildings
				46.43 (minor risk)	Destruction of school buildings during an earthquake due to lack of strength
				37.57 (minor risk)	Reduction of visual comfort due to lack of lighting and exposure
				37.57 (minor risk)	The inability of personnel to provide first aid to students due to the lack of first aid boxes in schools

Table 8-Risk prioritization based on the level of risk obtained in the HAZID technique

risk level	Risks of school's space	risk level	Risks of school's ground	risk level	Risks of school buildings
				37.57 (minor risk)	The inability to react in time when accidents occur due to the lack of first aid boxes in schools
				37.57 (minor risk)	Failure to prevent minor illnesses of students due to the lack of first aid boxes in schools
				12 (minor risk)	Failure to treat minor injuries and surface injuries due to the lack of first aid boxes in schools
				12 (minor risk)	Heat loss due to old windows caused by the lack of renovation of the building
				8.92 (minor risk)	Insulation problems in schools due to the old materials caused by the lack of renovation of the building
				8.92 (minor risk)	Destruction of school buildings with concrete frames during an earthquake
				4.31 (minor risk)	Transmission of pathogenic agents (fungal, infectious, and parasitic) due to lack of proper ventilation system
				4.31(minor risk)	Decreasing the level of air quality inside the classrooms due to the lack of proper ventilation
				0.76(minor risk)	The possibility of students falling due to lack of marking and securing of absorption wells and septic tanks in schools
				0.76(minor risk)	Destruction of the building due to vulnerable columns during an earthquake caused by the lack of retrofitting of school buildings
				0.76(minor risk)	Demolition of the building due to the lack of quality concreting caused by the lack of retrofitting of school buildings
				0.76(minor risk)	Destruction of the building due to improper concrete processing due to lack of retrofitting of school buildings
				0.76(minor risk)	The destruction of the building due to the failure to properly implement the partitions caused by the lack of retrofitting of the school building
				0.76(minor risk)	Destruction of school buildings due to the change in the type of use due to the lack of retrofitting of the building
				0.76(minor risk)	Destruction of the building due to lack of good welding due to lack of retrofitting of the building

An analysis of Fig. 2 reveals that the highest levels of unacceptable risks were identified across all three hazard categories, with the most severe risks being associated with the school grounds.

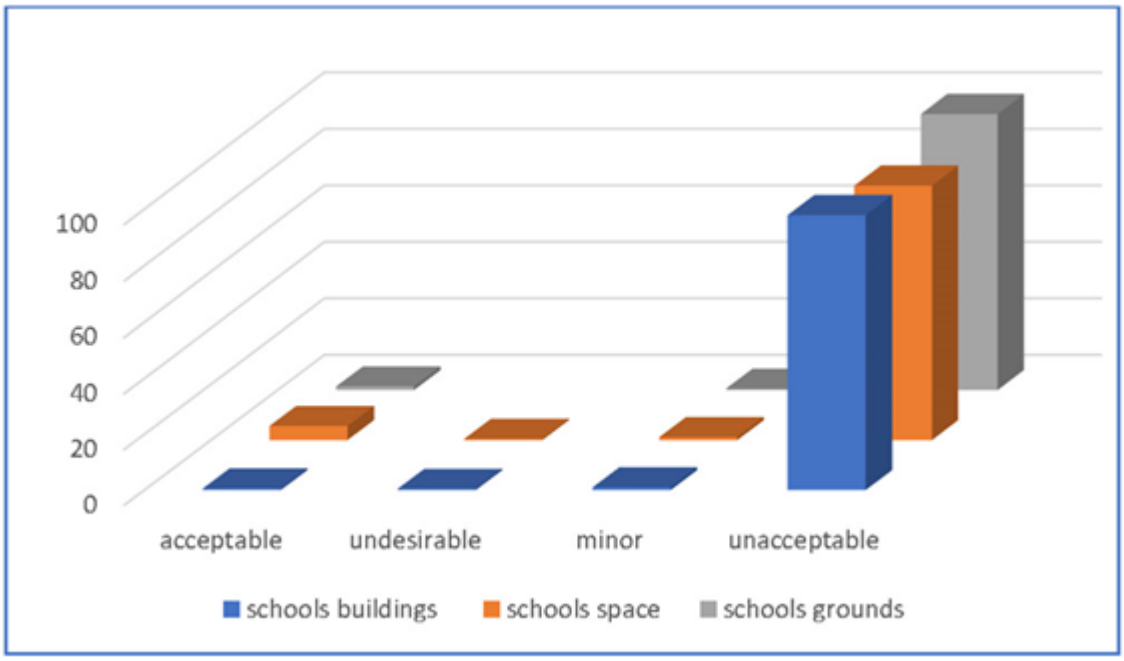

Fig.2 Comparison of three hazard centers in Ahvaz secondary schools

3.3. Strategy Design

Based on thorough investigations, expert judgments, and the cause-effect relationships identified through this research, several strategic issues have been highlighted. These challenges, concerns, and risks from the perspective of effective safety parameters for secondary schools in Ahvaz can be summarized as follows (see Table 9):

SO1: Focus of the Directorate General on the rehabilitation, development, and equipping of schools in Khuzestan Province, with special attention to key school safety categories.

SO2: Emphasis on systematic strategic operational thinking at the organizational level for modernization, development, and equipping of schools nationwide, particularly concerning school safety.

SO3: A systematic approach to design, implementation, re-engineering, strategic supervision, and continuous monitoring/auditing of school renovation and equipment projects, with a focus on safety.

SO4: Development of a comprehensive and integrated system for decision-making, administration, and strategic oversight of school remodeling and renovation projects, prioritizing safety.

ST Strategies:

ST1: The Department of Rehabilitation, Development, and Equipment in Khuzestan should document and issue official warnings to contractors who fail to comply with contractual safety requirements.

ST2: Ensure compliance with developed safety standards, technical guidelines, and construction codes during the design and construction of Ahvaz secondary schools.

ST3: Train school staff in crisis management, emergency response, and proper use of firefighting equipment.

ST4: Intensify safety measures during the renovation of Ahvaz secondary schools, particularly those made of masonry or concrete.

WO Strategies:

WO1: Enhance compliance with HSE (Health, Safety, Environment) regulations and requirements from contractors involved in school renovation projects.

WO2: Establish a comprehensive risk management system for land-related hazards affecting schools in Khuzestan.

WO3: Develop a risk management system for safety hazards associated with school buildings.

WO4: Focus on managing risks linked to school spaces and premises.

WT Strategies:

WT1: Optimize the budget allocation process for school reconstruction, renovation, and retrofitting projects with attention to safety aspects.

WT2: Minimize risks related to the location of schools near hazardous areas, such as factories, railroads, and high-traffic zones.

WT3: Eliminate sources of various security risks in Ahvaz secondary schools.

WT4: Increase collaboration between the Directorate General of School Rehabilitation and agencies focused on safety, such as the Provincial Standards Administration and Crisis Management bodies.

WT5: Address security threats posed by limited land availability and conflicting land uses near schools.

Strategic Policy Design Based on SO Strategies:

SP1: Diagnose and assess the decision-making processes within the General Department of School Renovation, Development, and Equipment in Khuzestan regarding school safety.

SP2: Avoid rushed and unsupported decisions in school safety policies.

SP3: Re-engineer the processes of design, implementation, supervision, and auditing to ensure a focus on safety.

Strategic Policy Design Based on ST Strategies:

SP1: Ensure that contractors comply with HSE requirements and avoid negligence.

SP2: Enforce thorough feasibility studies and compliance with design phases for school renovation projects.

SP3: Ensure strict adherence to architectural and structural safety standards in school construction.

SP4: Provide staff training in crisis response and the use of safety equipment.

Strategic Policy Design Based on WT Strategies:

SP1: Classify schools based on vulnerability and expedite funding for safety-related projects.

SP2: Improve coordination between departments and agencies dealing with school safety.

SP3: Enhance interdepartmental cooperation for school safety.

SP4: Prioritize safe geographic positioning for new schools, avoiding high-risk locations.

Table 9-Strategic macro and micro goals in line with policy-making and strategic stabilization of the safety situation in Ahvaz secondary schools

Strategic micro-goals	Strategic macro goals	Strategic issues
T_1: Systematic diagnosis of complications and damage strategic-operational science of provincial schools in Khuzestan, in the field of safety T_2: Drawing the mission statement and strategic mission of the school safety area of Khuzestan province, from the perspective of strategic management T_3: Designing a vision statement Strategic safety field of provincial schools in Khuzestan, from the perspective of strategic management T_4: Designing operational plans of strategic action for the field of school safety in Khuzestan province	G_1: Designing the comprehensive system and Integrated engineering again; minimization and management of strategic risks and safety hazards schools in administration total renovation; development and quipping schools Khuzestan province	SI_1: The mechanism of minimizing the intensity and range of risk types and safety hazards caused by space, land, and building Ahvaz secondary schools; despite severe restrictions budget of the General Department of Renovation, Development and Equipping of Provincial Schools Khuzestan SI_2: How to oblige the urgent need to do Geotechnical tests before the construction of secondary schools in Ahvaz SI_3: How to maximize the level of strength during the retrofitting process of secondary schools in Ahvaz, secondary schools in Ahvaz in a critical state; the reason the type of materials builders our masonry and concrete SI_4: The mechanism of maximization of the compliance level architecture and structural standards in design and construction processes Ahvaz Secondary Schools SI_6: The mechanism of empowering secondary school personnel Ahvaz regarding the methods of relief and dealing with the situation critical and emergencies, as well as working with firefighting equipment SI_7: How to remove the generating centers of pseudo-risk types risks and safety hazards at the level of secondary schools Ahvaz SI_8: The mechanism of minimizing safety threats caused by Inadequacy of location and inhomogeneity of land uses in the periphery of Ahvaz secondary schools; including proximity to factories and industries; proximity to railway lines; proximity to cemeteries and cemeteries; establishment in context worn out and urban traffic; establishment in the road boundary; a settlement in sloping lands; establishment in the privacy of pressure electricity strong; establishment exposed to floods and river boundaries; establishment in exposed to noise pollution; establishment exposed to air pollution caused by the penetration of fine dust and air pollution caused by burning sugarcane fields
T_1: Systematic diagnosis of complications and damage Strategic strategic-operational science of provincial schools in Khuzestan, in the field of safety T_2: Drawing the mission statement and strategic mission of the school safety area of Khuzestan province, from the perspective of strategic management T_3: Designing a vision statement Strategic safety field of provincial schools in Khuzestan, from the perspective of strategic management T_4: Designing operational plans of strategic action for the field of school safety in Khuzestan province	G_1: Designing the comprehensive system and Integrated engineering again; minimization and management of strategic risks and safety hazards schools in administration total renovation; development and quipping schools Khuzestan province	

Table 9-Strategic macro and micro goals in line with policy-making and strategic stabilization of the safety situation in Ahvaz secondary schools

Strategic micro-goals	Strategic macro goals	Strategic issues
T_5: Extracting opportunities and threats external, internal strengths and weaknesses of the administration total renovation; development and equipping of provincial schools Khuzestan in the field of safety		SI_5: How to change the passive approach; Facing the problem The axis and rationalist attitude governing the body of the modernization organization, developing and equipping the country's schools with an active approach preventive; strategy oriented exposure and macro view critical and critical area of school safety
T_6: Stratification of decision indicators making and making strategic decisions of the general administration renovation; development and equipping of provincial schools Khuzestan in the field of safety in the format of strategic components, strategic criteria, and Sub-criteria of strategy		SI_9: How to implement strategic thinking and system systematization of reengineering processes; renovation; rebuilding; periodic monitoring and audit of the General administration renovation, development, and equipping of schools in Khuzestan province with the centrality of the safety component in schools
T_7: Designing a range of scenarios and strategic plans for the safety of schools in Khuzestan province	G_2:Stipulation strategic and preparation strategic plan - operation of the general administration renovation; development and Equipping provincial schools in Khuzestan in the field of school safety	
T_8: Determining the vertices of monitoring indicators and Audit of the strategic-operational document of the general administration renovation; development and equipping of provincial schools in Khuzestan in the field of school safety		
T_9:Designing strategic policies For the safety field of Khuzestan province schools		

4. Discussion

The results of this study contribute to the growing body of research on school safety and risk management, particularly in the context of secondary schools in Ahvaz. Previous studies, both domestic and international, have primarily employed passive, problem-oriented approaches to safety risk assessment, focusing on immediate issues rather than long-term, strategic interventions. While techniques such as HAZID and J.H.A have been widely used for identifying hazards, they have often been applied in a fragmented manner, lacking an overarching strategic framework.

In contrast, this research aimed to adopt a proactive, preventive, and strategy-oriented approach, emphasizing a macroscopic view of safety management in schools. This novel perspective is significant because it highlights the importance of integrating strategic planning into safety management, a concept that has been underexplored in previous studies. For instance, research by Schmidt et al. (2020) has shown the value of adopting strategic frameworks in safety risk management, but their work focused on industrial settings, rather than educational institutions. By applying these principles to secondary schools, this study fills an important gap in the literature.

The first hypothesis, which proposed that the most critical strategic component in Ahvaz secondary schools' safety was related to building specifications and school features, was not proven. Instead, the findings suggest that safety risks in Ahvaz schools are distributed across various strategic components,

including the management of safety risk centers. This is consistent with findings from similar studies in urban settings, where diverse risk factors—such as building design, maintenance, and external environmental hazards—interact to create complex safety challenges (AlKheder et al., 2023).

The second hypothesis, which suggested that the majority of Ahvaz secondary schools face significant safety hazards, was confirmed by the data. This aligns with national and international studies, such as those conducted by Nyakundi (2012), which found that schools in rapidly urbanizing regions often struggle to meet safety standards due to inadequate infrastructure and insufficient regulatory oversight.

The third hypothesis, which posited that safety standards and regulations were the most important strategic criteria for assessing school safety, was not proven. The findings indicate that while regulations are important, the primary strategic concern lies in managing risks related to the physical condition of school buildings, particularly their technical specifications. This mirrors conclusions from studies in similar contexts, where structural integrity and building design have been identified as critical factors in ensuring school safety (Bradshaw et al., 2021).

5. Conclusion

This study underscores the importance of adopting a strategic, preventive approach to safety risk management in secondary schools, particularly in regions like Ahvaz, where schools face significant hazards. The confirmation of the second hypothesis—that many schools are at risk—highlights the urgent need for comprehensive safety assessments and interventions.

The findings suggest that while safety regulations and standards are crucial, they must be complemented by a focus on the physical condition of school buildings and the implementation of strategic safety measures. This proactive, strategy-oriented approach can provide a more sustainable solution to managing risks in schools, moving beyond the traditional passive methods of risk assessment.

Future research should focus on developing comprehensive frameworks for safety risk management that integrate both regulatory compliance and physical infrastructure improvements. Additionally, there is a need for further comparative studies to examine how strategic safety planning can be effectively implemented in different educational contexts, both within Iran and internationally. By fostering a culture of safety and strategic thinking in school management, policymakers and educational authorities can mitigate the risks faced by students and staff, ensuring a safer learning environment for all.

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REFERENCES

AlKheder, S., Alzarari, A., & AlSaleh, H. (2023). Urban construction-based social risks assessment in hot arid countries with social network analysis. *Habitat International*, *131*, 102730. https://doi.org/10.1016/j.habitatint.2022.102730

Bicalho, D., Santos, T. S. S., Slater, B., & Lima, T. M. (2021). Evaluation of quality indicators for management of the National School Feeding Program in Brazil: a systematic review. *Ciência & Saúde Coletiva*, *26*, 3099-3110. https://doi.org/10.1590/1413-81232021268.03802020

Bradshaw, C. P., Cohen, J., Espelage, D. L., & Nation, M. (2021). Addressing school safety through comprehensive school climate approaches. *School Psychology Review*, *50*(2-3), 221-236. https://doi.org/10.1080/2372966X.2021.1926321

Campos, P. (2020). Resilience, education, and architecture: The proactive and "educational" dimensions of the spaces of formation. *International journal of disaster risk reduction*, *43*, 101391. https://doi.org/10.1016/j.ijdrr.2019.101391

Hesami Arani, M., Jaafarzadeh, N., Khaleghi Dehabadi, P., Mostafaii, G., Tazik, M., Karimi, Z., Etesam, A., & Mohammad zadeh, M. (2020). Health and safety hazards identification and risk assessment in the swimming pools using combined HAZID and ALARP. *Environmental Health Engineering and Management Journal*, *7*(3), 151-160.

Hilbert, M. (2016). Big data for development: A review of promises and challenges. *Development Policy Review*, *34*(1), 135-174. https://doi.org/10.1111/dpr.12142

Kim, K., Kang, H., & Kim, Y. (2015). Risk assessment for natural gas hydrate carriers: a hazard identification (HAZID) study. *Energies*, *8*(4), 3142-3164. https://doi.org/10.3390/en8043142

Kour, R., Singh, A., & Ahire, N. (2020). An implementation study on Hazard Identification and Risk Assessment (HIRA) technique in the Critical Care Unit of a Tertiary Care Hospital. *Indian Journal of Forensic Medicine & Toxicology*, *14*(4), 4018-4026.

Lindfors, E., & Teperi, A.-M. (2019). Incidents in schools-incident analysis in developing safety management. Advances in Human Factors in Training, Education, and Learning Sciences: Proceedings of the AHFE 2018 International Conference on Human Factors in Training, Education, and Learning Sciences, July 21-25, 2018, Loews Sapphire Falls Resort at Universal Studios, Orlando, Florida, USA 9,

Luetz, J. M., & Sultana, N. (2019). Disaster risk reduction begins at school: Research in Bangladesh highlights education as a key success factor for building disaster-ready and resilient communities—A manifesto for mainstreaming disaster risk education. *Addressing the challenges in communicating climate change across various audiences*, 617-646.

McAllister, M., & Flynn, T. (2016). The capabilities of nurse educators (CONE) questionnaire: Development and evaluation. *Nurse Education Today*, *39*, 122-127. https://doi.org/10.1016/j.nedt.2016.01.022

Nyakundi, Z. O. (2012). Implementation of safety standards and guidelines in public secondary schools in Marani District, Kisii County, Kenya. *Kenyatta university*.

Pazzi, V., Morelli, S., Pratesi, F., Sodi, T., Valori, L., Gambacciani, L., & Casagli, N. (2016). Assessing the safety of schools affected by geo-hydrologic hazards: the geohazard safety classification (GSC). *International journal of disaster risk reduction*, *15*, 80-93. https://doi.org/10.1016/j.ijdrr.2015.11.006

Ranasinghe, U., Jefferies, M., Davis, P., & Pillay, M. (2020). Resilience engineering indicators and safety management: A systematic review. *Safety and Health at Work*, *11*(2), 127-135. https://doi.org/10.1016/j.shaw.2020.03.009

Sambasivam, S., Karuppiah, K., Subramaniam, K., Praveena, S., & Abidin, E. (2017). Potential safety risks in schools: Ensuring the safety of our precious ones. *Annals of Tropical Medicine and Public Health*, *10*(3). DOI:10.4103/ATMPH.ATMPH_81_17

Schmidt, C. (2020). Why risk management frameworks fail to prevent wrongdoing. *The Learning Organization*, *27*(2), 133-145. https://doi.org/10.1108/TLO-10-2019-0150

Seyedin, H., Dowlati, M., Moslehi, S., & Sakhaei, F. S. (2020). Health, safety, and education measures for fire in schools: A review article. *Journal of education and health promotion*, *9*(1), 121 doi: 10.4103/jeep.jehp_665_19

Vallinkoski, K. K., & Koirikivi, P.-M. (2020). Enhancing Finnish basic education schools' safety culture through comprehensive safety and security management. *Nordic journal of studies in educational policy*, *6*(2), 103-115. https://doi.org/10.1080/20020317.2020.1720069

Vilaça, T., Darlington, E., Velasco, M. J. M., Martinis, O., & Masson, J. (2019). *SHE School Manual 2.0. A methodological guidebook to become a health-promoting school*. Schools for Health in Europe Network Foundation (SHE).

Yu, C.-Y. (2015). How differences in roadways affect school travel safety. *Journal of the American Planning Association*, *81*(3), 203-220. https://doi.org/10.1080/01944363.2015.1080599

Yu, C.-Y., & Zhu, X. (2016). Planning for safe schools: Impacts of school siting and surrounding environments on traffic safety. *Journal of Planning Education and Research*, *36*(4), 476-486. https://doi.org/10.1177/0739456X15616460

Zaplluzha, S., & Shahini, M. (2016). Gender differences in the evaluation of school safety indicators according to adolescents in higher secondary schools in Prizren. *International Journal of Adolescence and Youth*, *21*(1), 27-33. https://doi.org/10.1080/02673843.2015.1027715