

# "Earthquake Disaster Risk Prevention and Cognitive Learning at the Universidad Nacional Mayor de San Marcos (UNMSM), in Metropolitan Lima-Republic of Peru"

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**Abstract:-** The earth is experiencing changes in the average temperature of the oceans and the geosphere, which are manifested through natural phenomenological events, such as: earthquake-earthquake, rain-flood, huaico-landslide, hailstorm-ice, avalanche- fall, tsunamitidal wave, dry electrical storm-lightning, strong wind-storm, fire-lava flow, pollution-spill, and others.

These natural phenomenological events are often associated and increased with the intervention and action of man (anthropic or anthropogenic phenomenology) and later actions of third parties appear (mixed phenomenology), which further aggravate the critical situation in intensity, magnitude and scope in the disaster scenario and possible consequences.

The UN, in accordance with the priorities and objectives of the Sendai Framework, seeks to support, promote and multiply scientific and academic efforts and public and private investment in disaster risk prevention and reduction, through the knowledge and use of science, technology and innovation, to implement structural and non-structural measures, with the objective of materializing disaster risk reduction through vulnerability reduction.

The essential purpose of the researchers is indicated in the first global objective of the MSendai "to substantially reduce world mortality from disasters by 2030 from 100,000 deaths annually, less in the period 2020-2030 than in 2005-2015".

This action aims to improve the economic, social, health and cultural resilience of people, communities, society, with their respective assets and livelihoods, as well as substantially reducing the damage caused by disasters, such as earthquakes. , to infrastructure considered critical and the interruption of basic services, particularly in educational facilities [universities and higher institutes], health, transport, communication and develop their capacity for recovery.

In this context, this research seeks to internalize scientific knowledge in university students, focused on

**the Prevention of Disaster Risks due to Earthquakes, through the Focus of Cognitive Learning through the Senses at the Universidad Nacional Mayor de San Marcos-UNMSM.**

The methodology used comprises the knowledge and grounded base experience, with the reading of empirical evidence and the literature review, having as the main source of data, natural disasters due to earthquakes, to then present a Cognitive Learning Design Proposal for the Senses for the Prevention of Risks by Earthquakes in university students.

**Keywords:-** Cognitive Learning, Disaster Risk Prevention, Higher Education.

## Glossary and scientific terminology

List of scientific terminology		
<b>Earthquakes [T]</b>	It is the sudden movement of the Earth caused by the release of energy accumulated over a long time, it also includes vibratory, rapid and violent movements of the earth's surface (collision of tectonic plates). They take the name of tremors or earthquakes. <sup>1</sup>	1
<b>Learning [A]</b>	Learning is the process through which the acquisition of knowledge, abilities, skills, behaviors, values and attitudes is sought, which is improved and consolidated with study, teaching, experience, instruction, reasoning and observation. (www.wikipedia.org, 2019)	2
<b>Cognitive learning [AC]</b>	The RAE defines learning as acquiring knowledge of something through study or experience. On the other hand, "cognitive" refers to "cognition" that defines the ability of the human being to know through	3

<sup>1</sup> (Brundtland Report, 1987)

	perception and the organs of the brain. (wordreference.com, 2019) <sup>2</sup>	
<b>Disaster risk prevention [PRD]</b>	Actions aimed at avoiding the generation of new risks in society and reducing existing vulnerabilities and risks in the context of sustainable development management. <sup>3</sup>	4
<b>Risk [R]</b>	It is a measure of the magnitude of the damage in the face of a dangerous situation. Risk is measured by assuming a certain vulnerability to each type of hazard. It is related to the probability of occurrence of a danger, threat (www.wikipedia.org, 2019). <sup>4</sup>	5
<b>Disaster risk [DR]</b>	It is the probability that the population and their livelihoods suffer damages and losses as a result of their condition of vulnerability and the impact of a hazard. (PCM, 2011)	7
<b>Natural disasters [DN]</b>	The term natural disaster refers to the enormous material losses and human lives caused by natural events or phenomena (earthquakes, floods, tsunamis, landslides, among others) (www.wikipedia.org, 2019)	8

### State of the art

The review of scientific and academic documents is part of the enrichment of the research content. In the search process we point out that we have found and referred exploratory and descriptive research, in other cases of mixed composition, with quantitative and qualitative approaches, in which four main thematic axes participate such as: [1] Cognitive Learning, [2] The senses and sub-senses, [3] disaster risk prevention and, [4] earthquake disasters.

We were able to identify that the research aims to (1) explain and (2) describe the models, resorting to historicity and empirical evidence, with a well-founded basis, which can be seen in zoning and participation of publications in countries of different geographical areas (five continents).

The investigations present development profiles, influenced by the use of technology. The use of statistical tools is present in most of the studies that we accessed. Among the most important that we choose, are those related to knowledge and cognitive learning of people and communities, in preventing the risk of disasters due to earthquakes.

<sup>2</sup> (wordreference.com, 2019)

<sup>3</sup> (PCM, 2011)

<sup>4</sup> (Lizardo Narváez, 2009)

Earthquakes turn out to have characteristics of unexpected and limited prediction, which brings with it unexpected and sudden changes in the behavior and behavior patterns of people (society and community) and structural and non-structural elements.

This special characteristic opens the opportunity to scientifically study the seismic risk prevention process, through cognitive learning using the senses and sub-senses of the person.

Finally, theoretical and practical concepts on the terminology used are updated, and there is evidence of ignorance and confusion in the semantic use of the terms "disaster prevention" with "disaster risk prevention", with nuances of post-disaster study positions, pertaining to reactive disaster risk management, mostly addressed under multidisciplinary approaches.

## I. INTRODUCTION

The research aims to develop a Cognitive Learning Design through the Senses, Applied to the Prevention of Disaster Risks by Earthquakes, to University Students of the UNMSM.

We wish to have the necessary information for Earthquake Risk Prevention actions, as a contribution of an academic and operational nature, in the social, cultural and personal safety aspects of the university institution. That it also serves as a referential input and representation model, for those scientific investigations that are carried out in the future. How, for example, how can be the Designs and Awareness Processes? the Design and Process of Preparedness and Response? and Modeling for Recovery, Rehabilitation and in the Reconstruction Process, in Scenarios of Earthquake Disasters.

They can also use them to associate them with research, the purpose of which is to assess Cognitive Learning in cases of disasters due to floods, tsunamis, tsunamis and those related to the use of Artificial Intelligence, the use of ICTs, within the framework of addressing Reduction of Disaster Risk, according to the Sendai Framework [2015-2030].

## II. INVESTIGATION METHODOLOGY

The elaboration of the research includes a methodological phase of literature review [LBD], and it has been important to consult the virtual Internet network, to extract statistical data and information on natural disasters due to earthquakes, and results on the progress of activities, on earthquake disaster risk prevention, under the deconstructive and descriptive lens of cognitive learning of human senses and sub-senses<sup>5</sup>.

The results indicate the capture of empirical information sources and also in a narrative way, which

<sup>5</sup> (Anna Elisa Bandecchi, 2019)

constitute the practical, viable and available tools, in a fast, simple and easy way, to capture, record, transmit and disseminate information in real time about the earthquakes, considered as potential threats (dangers), directly affecting 37,468 university students [30,866 undergraduate + 6602 undergraduate]<sup>6</sup> and 3315 professors [University Professors] in the university complex of the UNMSM.

With information, the research raises, elaborates a framework for the structural and non-structural vulnerabilities of the university campus, the risks of people (they include university students, teachers, administrative personnel, service and security personnel and visitors)<sup>7</sup>. This information obtained constitutes the basic input to carry out the corresponding study on the Prevention of Disaster Risks due to Earthquakes, using the lens of Cognitive Learning.

Focusing, first, on the protection and safety of people (such as students, teachers and administrative and general services staff). The information search process includes the objectivity and temporality of earthquakes, where keywords such as: "Cognitive Learning [AC] + Earthquakes [T] + Disaster Risk Prevention [PRD]", resulted in an interesting amount of relevant literature, even so, we made the decision to enrich it, for which it was considered appropriate to use keyword combinatorics.

The identified keywords are combined using logical operators to ensure that they follow the format required by the Elsevier search engine, Scopus, Science Direct, Google Scholar, and Springer.

**Keyword:** Cognitive Learning [AC], Earthquakes [T], Disaster Risk Prevention [PRD]

#### **A. Relevant aspects of the problem of the investigation by seismic activity**

One of the most important drawbacks when approaching disaster risk management is achieving an understanding of the key components, which involves reactive and corrective management of earthquake disaster risk.

The literature review [LBD] tells us about the efforts made to date, which have been aimed at describing and explaining situations that occurred in the past [Post-disaster, "after"].

That they constitute empirical evidence (based on grounded) and experiences (such as experiential experience) of disasters due to earthquakes, heavy rains, hurricanes, cyclones, cold weather, mining spills, volcanic lava spills, floods, landslides, storms and many forms of manifestation of phenomenological events.<sup>8</sup>

Natural phenomenology translates into natural disasters, these post-disaster evidences (identified as

reactive management elements) and they have been broadly addressed in some countries, in which cases of Japan, the United States, Chile, Spain, England are noted. China and others have devoted considerable financial, material and human resources to them, as well as time and assessment of priorities.

Issues related to damage assessment and calculating million-dollar losses have been mostly addressed, in the disaster scenario, and as always, following the guidelines of the Hyogo Framework for Action [2005-2015], such as the recommendations of the UN (Sustainable Development [SD] and International Strategy for Disaster Reduction [ISDR]). At present, it has been working under the umbrella of the Sendai Framework Agreement [2015-2030], in this current it has been possible to promote and strengthen scientific and academic research, aimed at the Prevention and Reduction of the Risk of Disasters with the use of intensive of Science, Technology and Innovation, focused on Corrective Disaster Risk Management [looking at the current scenario, "what the present means"].

#### **The need to incorporate disaster risk management in the UNMSM**

Taking into account the institutional level of the UNMSM, we can indicate that, in 2013, the Office of Risk Management and Adaptation to Climate Change [GR and ACC] was created. The same that according to the information of officials who direct it, has been operating in a slow implementation process and with the evident lack of technical, scientific, normative and legal knowledge to implement Disaster Risk Management. This reality of the university institution has been compromised and prevented from making significant progress in preventing the risk of earthquakes disasters. A series of dependent activities also appear and are exacerbated by a limited and austere operating and economic budget assigned to the Office of GR and ACC.

The lack of resources has been affecting the process of institutional articulation of Disaster Risk Management in the internal part. At the level of interrelation at the national level with other university scientific research institutions, as it has also weakened the projection at the international level with other countries<sup>9</sup>.

This contemplated situation and the temporality of the GR and ACC Office, creates the need and importance of associating and articulating it in an institutional way with the National Disaster Risk Management System [Sinagerd], the Ministry of Education [Minedu], the National Institute of Civil Defense [Indeci] and the National Center for Estimation, Prevention and Reduction of Disaster Risk [Cenepred].

This articulation will facilitate the institutional implementation in a technical, academic and scientific way of the university house and is binding on the international agreements that have been signed, firstly, with the Hyogo

<sup>6</sup> [https://es.wikipedia.org/wiki/UNMayor\\_San\\_Marcos](https://es.wikipedia.org/wiki/UNMayor_San_Marcos)

<sup>7</sup> (Serov, *Cognitive Sensor Technology for Structural Health Monitoring*, 2017)

<sup>8</sup> (Fernandez Arce & Chavarría Córdova, 2012)

<sup>9</sup> (Valerie November, Ivan Leanza, 2015)

Framework for Action, which was promoted and promoted by the Organization of the United Nations [UN].

At present, it has been operating with a greater impulse of participation from international scientific organizations, as well as professional and recognized members, for the arduous work in research. This globalized coordination has given rise, with the ordering and direction of the accompaniment with one hundred and fifty researchers, belonging to the main university centers and academic institutions and scientific research of global and multidisciplinary scope.

The idea of the United Nations (UN) World Organization has been to structure a new and updated agreement, which took the name of the Sendai Framework whose period of validity comes from 2015 to 2030.

This framework of action takes into account four priority axes and among them has established the importance of making use of Science, Technology and Innovation.<sup>10</sup>

This priority objective goes from a reactive status quo, called reactive disaster management, "after", to one of corrective status quo, which is related to corrective disaster risk management, that is, "looking at the present, now", prioritizing scientific research through the intensive use of Science, Technology and Innovation.

This priority objective number 1, delves into the understanding and knowledge of risk, which implies shredding (fraying) the process of disaster risk management, through disaster risk prevention and disaster risk reduction, these Joint actions will facilitate us with the sharing of characteristics and appropriate concepts, which can be managed in a common denominator and under a semantic structure that is understandable, accepted and shared by the countries that participate worldwide.

**The problem of social responsibility of Disaster Risk Prevention (PRD) in the university community**

The absence of Knowledge and thematic corresponding to the Prevention of Disaster Risks, to form a network of participation and involvement by the duly informed University Community, creates the opportunity and option to deploy efforts to propose and elaborate the Cognitive Learning Design to understand and generate knowledge of Disaster Risk Prevention, using people's senses and sub-senses, applied to Earthquake Disaster Risk Prevention, at the Universidad Nacional Mayor de San Marcos-UNMSM. This attitude of deepening the senses and sub-senses, related to the critical moment of decision due to the experience of the earthquake, is immediately reflected in the neuronal and sensitive part of the person's brain,

The research aims to interpret and describe the situation that a student goes through at the moment of the earthquake, which compromises the Universidad Nacional Mayor de San Marcos, this situation has as its starting point

our Information related to the Cognitive Learning Design Proposal through the senses and sub-senses, in a process of dynamics and movement.

This action includes the academic effort to facilitate and prioritize the institutional implementation of Disaster Risk Management to associate, articulate, support the development of scientific research at the university and in all study faculties, in this way we contribute to compliance and institutional formality within the framework of Law No. 29664 of the National Disaster Risk Management System [Sinagerd], to guide, update and facilitate institutional liaison and strengthening in the international context, as stipulated in the Sendai Framework of the UN [Period 2015-2030].

**Notes on earthquake disaster risk**

The notion of risk [R], from the conception process, through history and in a broad and understandable way, exists, since the beginning of man's presence on earth, and we are alluding to ideas, about losses and damage, associated with dangers and threats in the different spheres of human activity carried out to date.

It must also be recognized that since the beginning of the millennium "the notion of risk is inherent to the business idea and the search for advances in human knowledge and profitability, under certain conditions of probability and uncertainty."<sup>11</sup> By making specific reference to the problem of disasters-circumstances or social conditions in which society is significantly affected by the impact of physical events of various origins, such as earthquakes, hurricanes, floods or explosions, with consequences in terms of the disruption of normal life and frequent operating levels. We are facing a notion or concept of particularized risk, what we can call "disaster risk" or "risk that foresees future disaster". This risk constitutes a subset of the "global" or total risks. If the interrelationships between its multiple parts are considered, there are close relationships with the facets with which the global risk is described, such as:

Known Risk Examples		
Bacteriological risk,	Financial risk,	Medicinal risk,
Port risk,	Credit risk,	Pollution risk,
Occupational hazard,	Health risk,	Sports risk.
Mining risk,	Technological risk,	Aeronautical risk
Agricultural risk,	Risk in transport,	Electric risk,
Risk of flooding,	Maritime risk,	Chemical hazard
Health risk,	Airport risk,	Sports risk
Risk in transit,	Aeronautical risk,	Risk of personal accidents
Pedestrian risk,	Food risk	Other risks.

<sup>10</sup> (Indeci, 2010)

<sup>11</sup> (Indeci, 2006)

### Disaster Risk Algorithm Analysis

When making specific reference to the problem of disasters, it includes those circumstances or social conditions where society has been significantly affected by the impact of physical events of various origins, also known as phenomenology, such as earthquakes, hurricanes, floods or explosions, with consequences in terms of the interruption of the continuity and daily life, and the levels of normal operation. Here, we are faced with a notion or concept of particularized risk, what we can call "disaster risk" or "risk that heralds future disaster".<sup>12</sup>

This risk constitutes a phase or stage of the "global" or total risk and, considering the interrelationships between its multiple parts, it will have close relationships with the facets with which the global risk is described, hence this definition emphasizes the threat or the event. physical trigger of the disaster. (Lizardo Narváez, 2009)

### The risk, danger (threat) and vulnerability

**A natural hazard** It can be defined as the probability that a territory and the society that inhabits it, are affected by natural episodes of significant magnitude and extraordinary range, in summary:

**Risk = Danger (Threat) X (\*) Vulnerability<sup>13</sup>**

(Analyzing the risk based on the degree of (1) exposure, (2) fragility and (3) resilience).

On the contrary, anthropic (anthropogenic) risks are risks caused by human action on nature, such as pollution caused in water, air, soil, overexploitation of resources, deforestation, fires, among others.

**The risk** It is known as chance and refers to the probability that a certain natural phenomenon, of a certain extension, with intensity, duration, and associated with negative consequences, will occur in a well-defined place, time and location. The analysis of return periods or the representation of frequency maps is the object of this first part. (Brundtland Report, 1987).

**Vulnerability** refers to the impact of the phenomenon on society, which in these cases refers to living beings and organisms, in groups and forming associations, and it is precisely the increase in vulnerability that has led to a greater increase in natural risks.

Vulnerability ranges from land use to the structure of buildings and constructions, and strongly depends on the population's response to risk.

### The scientific world and the risk of earthquake disasters in society

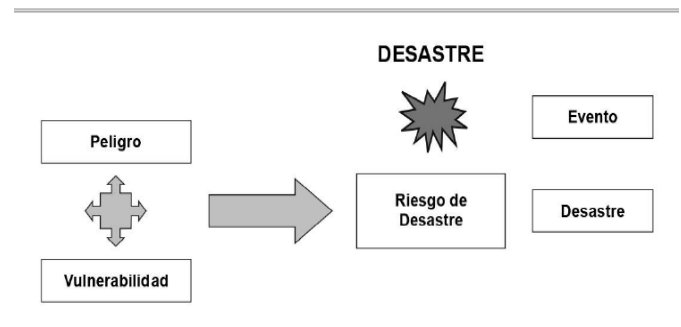
In December 2014, an important group of scientists [more than 140 recognized members of various nationalities of the world], worked on an international document called the Sendai Framework for Disaster Risk Reduction (2015-2030), adopted by UN member countries, on March 18,

<sup>12</sup> (Tomás Labbé Atena, 2019)

<sup>13</sup> (www.cenepred.gob.pe, September 2015)

2015, at the World Conference on Disaster Risk Reduction in Sendai, Japan.

Image N ° 1 Presentation of disasters



Source: Own elaboration of Disaster [Risk, Danger and Vulnerability]

### Background of the earthquakes in Peru

The territory of the Republic of Peru is an area of frequent seismic activity, and corresponds to the friction strip of the relative movement of two tectonic plates: the Nazca plate, which occupies a large part of the subsoil of the Pacific Ocean and whose edge generates a strong collision, which extends from Panama to southern Chile. Additionally, we have the South American plate, which ranges from the Peru-Chile marine trench in the west, to the axis of the South Atlantic Mountain Range in the east of the South American continent.

The Nazca plate moves in a North 80 ° East direction, at an average speed of 11 centimeters per year, and the Nazca plate also undergoes a subduction process (intense pressure and high temperature) below the South American plate and this This process gives rise to earthquakes of significant intensity on the western edge of South America.<sup>14</sup>

As for the antecedents of this type of phenomenological events, we have the occurrence of one of the deadliest earthquakes of humanity and it happened in the Republic of Peru, it was during May 31, 1970, more than 66,000 deaths occurred, the researchers Socialists consider it the most destructive earthquake in the history of Peru and it was registered in the Central Andes in 1970 and left between 50,000 and 80,000 people seriously affected.<sup>15</sup>

The 45-second, 7.8-magnitude earthquake destroyed the city of Huaraz in the Department of Ancash (which lost half its population) and caused a landslide that buried and erased the city of Yungay, in the central Peru.<sup>16</sup>

### Manifestation and repercussions of natural phenomenology by earthquakes

First, we are going to take into account the physical and natural conditions of the southern hemisphere, which place the Republic of Peru as a country within the circle of

<sup>14</sup> (Statista, 2020)

<sup>15</sup> (SENDAI SMarco, 2014)

<sup>16</sup> (Indeci, 2010)

fire and exposed to imminent phenomenological dangers. The geography of the Peruvian territory generally presents the following characterizations:

A priori characteristics of the Peruvian territory	Order	Frequency
Presents high seismicity (permanent volcanic activity)	1	high
Climate changes (El Niño and La Niña phenomena)	2	Half
Climate changes (Coastal Niño Phenomena, El Niño Modoki)	2	Half
Climate changes (Coastal Child Phenomena 3,4)	2	high
<p><b>Geological events and phenomena</b> Among the best known and most common that obey the dynamics of nature, we have:</p> <ul style="list-style-type: none"> <li>• Rain-flood</li> <li>• Huaico-slip</li> <li>• Slush-ice</li> <li>• Earthquake-earthquake</li> <li>• Avalanche-barrage</li> <li>• Tsunami-tidal wave</li> <li>• Dry Electric Storm (TSE) -lightning</li> <li>• Strong wind-storm</li> <li>• Fire-lava flow</li> <li>• Pollution-spill</li> <li>• Frost-cold</li> <li>• Volcanic eruption-lava</li> </ul> <p><i>Phenomenological events that are studied and recorded in the National Disaster Risk Management System -Sinagerd, Cenepred (National Center for Estimation, Prevention and Reduction of Disaster Risk), Indeci (National Institute of Civil Defense) and Ministry of Defense (Mindef).</i></p>		

This scenario is mainly due to the geographical location of Peru, on the southern eastern edge of the Pacific Ocean and its approach to the tropical region of South America, and represents the territorial area where the El Niño Phenomenon is manifested recurrently, and with the proximity to the Andes Mountains, in both a great variety of microclimates are generated, all these factors considerably increase vulnerability, accentuated in the north, center and south macro region of the country.<sup>17</sup>

### B. Earthquake Disaster Risk Prevention (PRD) as a global commitment

The Sendai Framework for Disaster Risk Reduction (2015-2030) is an international document, adopted by UN member countries between March 14 and 18, 2015, during the World Conference on Disaster Risk Reduction, held in Sendai, Japan, and approved by the United Nations General Assembly in June 2015. The Sendai framework succeeds the Hyogo Framework for Action (2005–2015), which until then had been the most important international agreement on disaster risk reduction.<sup>18</sup>

<sup>17</sup> (Indeci, 2010)

<sup>18</sup> (SENDAI SMarco, 2014)

Marco de Sendai's document was the result of 3 years of talks, supported by the United Nations Office for Disaster Risk Reduction, during which UN member countries, NGOs and other actors called for an improved version of the Hyogo's existing Action framework. This improved version was to incorporate a set of common standards, achievable objectives, and a legal-based instrument to reduce disaster risk. Member countries also highlighted the need to address disaster risk reduction and adaptation to global warming when setting the Sustainable Development Goals (SDGs), particularly in light of insufficient attention to risk reduction and resilience in the Millennium Development Goals (on which the SDGs were based).

In March 2015, the member states of the United Nations agreed on new guidelines for the challenge of reducing disaster risk. The document was called the Sendai Framework for Action, after the Japanese city where it was signed. It replaced the Hyogo Framework for Action, established ten years ago. Hyogo helped raise public awareness and generate political commitment. During its term, the countries made progress in reducing mortality. However, one of the weaknesses was the limited progress in considering disaster risk within the formulation of countries' priorities, that is, protecting development advances against disaster risk.

Based on what has been learned, the Sendai Framework calls for a greater integration of disaster risk reduction, as a central element to be considered in development planning and of the various sectors with a vision and way of advancing towards resilience.

### The Sendai Framework and the priorities of a globalized world

The Sendai Framework Agreement establishes four [4] concrete priorities for immediate action, such as:

- [1] Understand disaster risk.
- [2] Strengthen disaster risk governance for better management.
- [3] Invest in disaster risk reduction for greater resilience.
- [4] Increase preparedness for disasters, to better respond to them and for better recovery, rehabilitation and reconstruction.

To support assessment of progress towards reducing disaster risk, seven [7] global targets have been agreed<sup>19</sup>:

- [1] Substantially reduce global mortality from disasters by 2030, with 100,000 fewer deaths annually in the 2020-2030 period than in the 2005-2015 period.
- [2] Substantially reduce the number of people affected by disasters by 2030, with 100,000 fewer affected annually, in the period 2020-2030, than in 2005-2015.
- [3] Reduce the economic losses caused by disasters in the world Gross Domestic Product (GDP) by the year 2030.
- [4] By 2030, substantially reduce the damage to critical infrastructure and the disruption of basic services (including health and educational facilities) caused by

<sup>19</sup> (SENDAI SMarco, 2014)

disasters, through increasing their resilience, among other measures.

- [5] Substantially increase the number of countries with national and local disaster risk prevention and reduction strategies by 2020.
- [6] Substantially increase international cooperation with developing countries, through adequate and sustainable support, to complement their national actions to implement the Sendai Framework by 2030.
- [7] Substantially increase by 2030 the availability of multi-hazard early warning systems and the population's access to these systems.

### **Understand disaster risk from a scientific and technological lens**

#### **Priority 1: Understand disaster risk**

- It covers all its dimensions:
- threat characteristics,
- vulnerability,
- capacity and degree of exposure of the population, and the environment.

#### **Some Actions:**

National and local level

- Collect, analyze and disseminate relevant data and practical information.
- Systematically record and report losses caused by disasters<sup>20</sup>.

#### **Global and regional level**

- Promote the dissemination of scientifically based methodologies and tools to record and report losses.
- Promote comprehensive studies and data sharing.

### **Increase Earthquake Disaster Risk Prevention (DRP)**

**Priority 4:** Increase disaster preparedness to better respond to them and for better recovery, rehabilitation and reconstruction.

- It encompasses increasing preparedness
- Sufficient capacity to respond to disasters must be ensured.
- Timely preparation and, later, rebuilding must integrate risk reduction<sup>21</sup>.

#### **Some Actions:**

National and local level

- Periodically update preparedness and contingency plans and programs.
- Develop and strengthen early warning and hazard prediction systems.
- Promote the resilience of new and existing vital infrastructure.
- Strengthen the capacity of local authorities to evacuate disaster-prone areas

#### **Global and regional level**

- Develop and strengthen regional approaches and coordinated mechanisms.
- Disseminate codes, guides and other guidance instruments.

<sup>20</sup> (Toinpre, 2018)

<sup>21</sup> (SENDAI SMarco, 2014)

### **C. Cognitive Learning and Earthquakes**

**Definition:** It is defined as the accumulation (a set and summation) of knowledge (individual person or animal), which is acquired during the time horizon (translated as life) and which is the result of study, research and experience in a way, direct or indirect (Mario, 2017). It should also be noted that learning is an inherent, structural and enriched part of people's experience, on a day-to-day basis, with the processing and the degree of importance and usefulness of what we do with this information.<sup>22</sup>

#### **Duration of cognitive learning**

In the case of human beings, the brain receives information constantly, every day, through the senses, some in greater proportion than others, such as the sense of sight, and in this transcendental part, we refer to the importance it has in the movement, in the identification of the environment, in the shapes and colors, among those of greater amplitude and utility. The processing of information in the mental scheme, progressively feeds the reasoning, and this process of association and relationship with the environment is deposited and stored in memory, as we said before, it is a process that accumulates during the time that the person is socializing, interacting constantly and at all times and covering a duration of the entire life cycle.<sup>23</sup>

#### **We will start by knowing how our senses work**

Common sense explicitly leads us temporarily and almost always, to locate ourselves at a certain moment in our lives, and to reflect on why we are capable of being aware of different situations such as:

- [a] The affinity to notice the tastes and flavors during a certain time,
- [b] The power in the person to be sensitive to perceive different smells,
- [c] Manage to experience the bodily sensation of capturing the temperature (highs and lows),
- [d] Get to feel the movement and vibrations of the ground, caused by seismicity in the square meter that we occupy,
- [e] Being able to listen to different sounds and be able to identify the sounds emitted by people and materials,
- [f] Perceive the sensation of the air in contact with the body and close to it,
- [g] Instantly observe and define the occurrences or events near the place where we are physically located,
- [h] Mentally build the stage and see what happens around us,
- [i] Establish and fix reality momentarily and in a certain space, etc.

In this way we can make a long relationship and review of these actions, which human beings perform, as the prelude and review to understand and achieve cognitive learning, and incidentally know how our senses and sub-senses work.

<sup>22</sup> (Takako Izumi RS, 2019)

<sup>23</sup> (Change, 2017)

Always and in a traditional way, human beings are considered to have five senses:

- [1] The view,
- [2] The touch,
- [3] The sense of smell,
- [4] Taste,
- [5] The ear.

If we analyze the latest trends in neuroscience and neuro pedagogy, they seem to indicate that there really would be more than five senses, for the research we carry out we will try to be deeper, in having the greatest amount of information, concepts and elements to deconstruct the process of disaster risk prevention, under the lens of cognitive learning.<sup>24</sup>

Simple examples of daily life, such as tasting food, perceiving pain, noticing the temperature of the environment, feeling smells, seeing what surrounds us, etc., would be impossible without our senses, which are the part of our nervous system in charge of the capture of stimuli, under this motor dynamics of the senses, these.... "constitute the ideal machine and designed to perfection", to collect the information of everything that is part of what is external to us, so that our brain is capable of interpreting it and giving rise to a response, under three manifestations, such as [1] psychological, [2] anatomical and [3] physiological, as it relates to what we have perceived during the experience.

### The deconstructed senses under the lens of Cognitive Learning

In order to unravel the use of the senses in a broad way, we were able to identify up to twenty-six [26] senses and sub-senses of the human being, appropriate for the investigation of cognitive learning, based on approaches from human medicine, neuroscience, psychology and psychiatry, for the needs of scientific research, driven by a scientific desire, in the search for various forms of perceptions typical of the human being.

The main search tool for new meanings, we have carried out on the exploration of those already known, which have been conveniently subdivided and grouped by affinities of specific capacities<sup>25</sup>.

### The Senses and Subsenses

Next, we present the subdivisions of the senses as follows:

- [1] **The perception of light:** Probably should be considered within the group of important, and we place it as the sub-sense of sight.
- [2] **Color perception:** It includes being part as a sub-sense of sight, to differentiate colors and shades.
- [3] **The audition:** It is the sense with which we are familiar, and is associated with our ability to detect danger and delve into how to survive.

<sup>24</sup> (Mario, 2017)

<sup>25</sup> (Tomás Labbé Atena, 2019)

- [4] **The sense of smell:** It is one of the senses, which is known as one of the most primitive we have and is associated with our ability to detect environmental and spatial security conditions.
- [5] **Taste:** It is known as one of the senses associated with the pleasant and is divided into several sub-senses, each with specific capacities and concrete functions.
- [6] **The perception of sweet taste:** It becomes part of the sub-sense of taste, which we develop earlier in the growth stage of people.
- [7] **The perception of salty taste:** Also, it is an important part such as the sub-sense of taste, which allows us to taste most of the foods we eat, related to calcium chloride, potassium chloride, food salt, etc.
- [8] **The perception of sour taste:** It has to be related to the sub-sense of taste, people develop especially from an early age, to detect those foods considered harmful or dangerous for our body.
- [9] **The perception of bitter taste:** It is also a derivative as a sub-sense of taste, people develop it specially to detect when a food is not considered within the range of acceptable and pleasant.
- [10] **The touch:** People know and experience it, the differentiation is in the form of division into sub-senses, such as thermo perception and nociception.
- [11] **Nociception:** It is known as the ability of the human being to feel pain, this sense is associated with the survival instinct of people.
- [12] **The mechanoreception:** It comes to be related to the motor capacity of the individual, to give an immediate response, people use this sense fully, with acute reflexes and we can trust the response of our muscles and the movements that start from them.
- [13] **The balance of the body:** It can be assigned the label of the most important senses of all known. It is located in the sense of hearing [hammer, anvil and stirrup], normal employability makes it possible for us to maintain balance, to stand, walk, run, jump, dance, etc. and it is related to the challenge of surviving risky situations.<sup>26</sup>
- [14] **Proprioception:** It is the ability to perceive our own body, it includes the actions of what allows you to take care of yourself, get dressed or bathe, even with your eyes closed, it includes the moment that you cannot see or touch yourself, somehow you know where it occupies your body and how its parts are distributed. They are basic and if you lacked this sense you would suffer from continuous clumsiness, you would also stumble and collide with everything when walking.
- [15] **Kinesthesia:** It is known as perception related to movement, it is associated with our body in some way and has the ability to perceive and predict movement, when this happens, we are using the properties of our kinesthetic sense.
- [16] **Thermoception:** Also, it is known as the perception of temperature, it works internally and can be considered in this sense, as a sub-sense of touch, with the specific function of informing us if our body temperature is healthy and normal.

<sup>26</sup> (Tomás Labbé Atena, 2019)



- [17] **The perception of cold:** Relates to the human body and allows us to perceive the temperature coming from outside, and alerts us to protect ourselves early and act with the purpose of safety.
- [18] **The perception of heat:** It is part as well as the perception of cold, this time it is heat, high temperatures, it empowers us to capture the temperature of our environment, warning us in case we must put a defense barrier, to protect ourselves and not be hurt.
- [19] **Interception:** We identify it as the sub-sense of the internal perception of the body, related to the sensation of the internal level of liquids in the body itself.
- [20] **Blood pressure:** Through this sense it allows us to keep our blood pressure in a constant and balanced way, it is not done in a conscious way (compared to all other senses), but the body has the condition and ability to regulate it frequently.
- [21] **Oxygen content in the blood:** This sense, in the same way as blood pressure, responds to an internal ability of the body that performs a control and regulation function in the body.
- [22] **Cerebrospinal fluid PH:** It is a very important substance in the body and fulfills the same function as the two previous senses.
- [23] **The osmotic pressure of the plasma:** We explain it as the form, when our body uses this sense all the time and frequently, every time some substance must cross a barrier (go through a permeable membrane) in our body, we make use of the osmotic pressure of the plasma, sub -sense linked to human health.
- [24] **Blood glucose level:** It is a key point and is also considered important for the normality of the human body, with this sense, physical and emotional stability can be partially lost, values outside the range of acceptance and scale, it can bring serious consequences for health.
- [25] **Inflammation of lungs:** The importance of this sense allows us that the lungs inhale and exhale when we breathe, it is essential and we cannot live with the total absence of this sense, because it would cause us death in a short time.
- [26] **Synesthesia:** This characteristic is developed only by some human beings, and considered by certain branches of medicine as a perceptual disorder, in a human being with synesthesia perception it can associate stimuli that correspond to one sense, with another sense, this means that it can perceive a color when listening to a piece of music or feel the acid taste of a texture, and the closest thing to synesthesia is the association made between smell and taste<sup>27</sup>.

**Cognitive Learning and the senses associated with earthquake disaster scenarios**

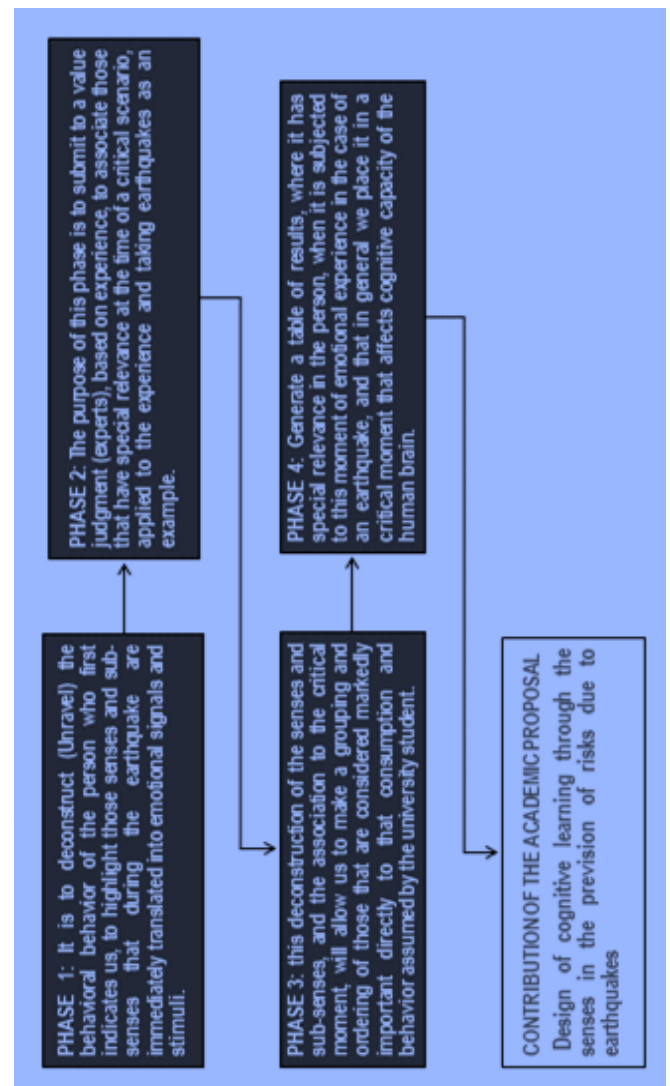
In the process of implementing disaster risk management in the UNMSM university institution, for earthquakes [high seismicity], it opens an opportunity and window to carry out and dedicate efforts to scientific research, in order to facilitate and integrate prevention and

disaster risk reduction in university spaces and environments.

In this context, earthquake disaster risk prevention research through Cognitive Learning in the house of studies, seeks to deepen scientific research, taking as its main axis, the corrective component of disaster risk (that is, when we talk about the present, now), which are located within the disaster risk prevention process. The researcher intends to make use of the knowledge and understanding of disaster risk, through the senses and sub-senses of the person, making use of Cognitive Learning, this deepening of the senses and sub-senses of the person, serves as the basis for identifying the behavioral and behavioral elements, when subjected to critical moments, of emotional impact [emotional shock],<sup>28</sup>

**Stages for Design of Cognitive Learning by the Senses in Earthquake Risk Prevention**

Image N ° 2

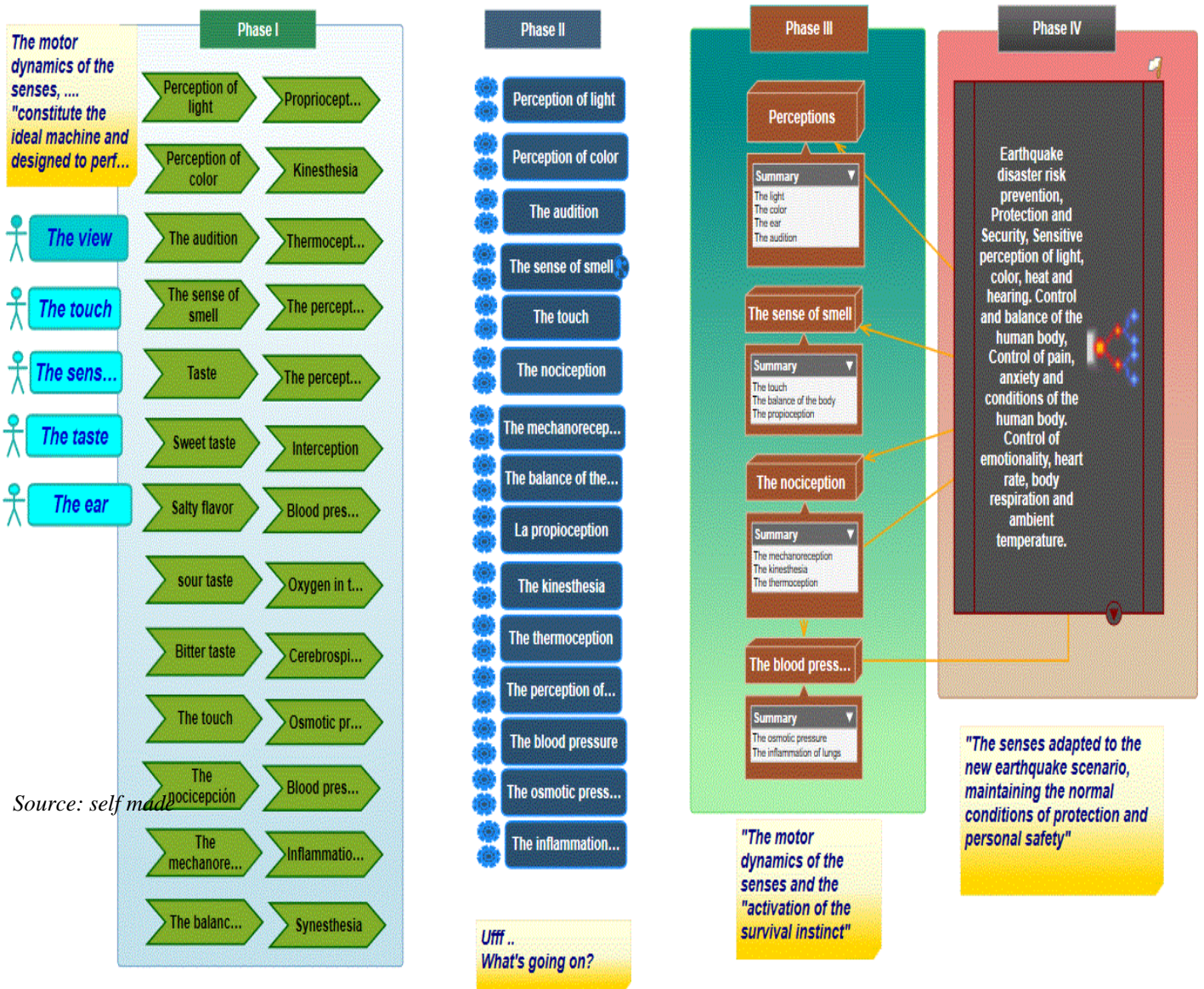


<sup>27</sup> (Mario, 2017)

<sup>28</sup> (Zimolong, 2016)

Cognitive Learning Design by the Senses for Earthquake Risk Prevention Image N ° 3

The deconstructed senses under the lens of Cognitive Learning by Earthquakes



**Phase 1:** During the process to deconstruct [unravel] the behavioral behavior of the person, initially, it signals and leads us to highlight those senses and sub-senses, which during the earthquake are immediately translated into emotional signals and stimuli that last tenths of seconds. This photograph for the moment leads us and forces us to identify a reality instantaneously, which allows the emission of small signals, which materialize through the reaction in the brain, for then, and immediately, accelerated and forceful, is associated through electrical stimuli, with the senses and sub-senses involved in the reaction process of the brain and human body<sup>29</sup>. See Image N ° 2.

**Phase 2:** The purpose of this phase is to submit to a value judgment (experts), based on experience, to associate those that have special relevance at the time of a critical scenario, applied to experiences and taking earthquakes as an example. The contribution of the research is reflected in the common sense of making an association duly analyzed, under the rigor of importance that we assign to it, in the process corresponding to the relationship and association, in the manifestation of the senses and sub-senses embodied in the construction of the Cognitive Learning Design, through the senses and sub-senses, all of them focused on the moment that the person emotionally experiences the impact of the earthquake<sup>30</sup>.

**Phase 3:** Once the senses and sub-senses that have special relevance in this key moment of crisis have been identified, we are going to proceed to the selection of those that have the greatest impact at the moment for the person, and that are part of the behavior and conduct that the individual assumes At the time [emotional shock], this deconstruction of the senses and sub-senses, and the association to the critical moment, will allow us to make a grouping and ordering of those that are considered markedly important and directly affect this behavior and behavior assumed by the college student<sup>31</sup>.

**Phase 4:** After doing the grouping, we will proceed to generate a results table where priority will be given to the senses and sub-senses that have special relevance in the person. When it is subjected to this moment of emotional experience in the case of an earthquake, and what in a general way we can frame it in a critical moment and an emotional shock, which undoubtedly affects the cognitive capacity of the human brain.

### **Process for preparing the Earthquake Risk Prevention Learning Design**

In the work to explain the behavior of the person due to the occurrence of a seismic disaster, we are going to elaborate a Cognitive Map summarizing the five phases of the Cognitive Learning process, with the deconstruction of the senses and sub-senses. See Image N ° 3.

<sup>29</sup> (Anna Elisa Bandecchi, 2019)

<sup>30</sup> (Tomás Labbé Atena, 2019)

<sup>31</sup> (Mario, 2017)

The selection, grouping and ordering by participation and importance of those with the highest incidence, to be considered in the final section, assuming an important role and performance to elaborate the Cognitive Learning Map based on the senses and sub-senses, which allows us to integrate the Disaster Risk Prevention for earthquakes, making use of Cognitive Learning.

The research is aimed at proposing a Cognitive Map Design, which allows to identify, prioritize and prioritize the usefulness in the process of assigning them to students, the use of these alternatives in behavior and conduct to take them and prepare them to a recommended security context [geospatial location] and added to personal protection [physical and emotional condition] on the university campus.

### **Cognitive Learning Design Proposal for the Senses for Earthquake Risk Prevention**

The purpose of the research contribution is to “Develop and Present a Cognitive Learning Design Proposal under the Lens of Senses and Subsenses, applied to the Prevention of Disaster Risks by Earthquakes” [see Image 3 of Cognitive Learning Design by Senses for Earthquake Risk Prevention].

### **Cognitive Learning for earthquake protection and safety in the university community**

On the other hand, we consider it important to have the "Design of Cognitive Learning by the Senses for the Prevention of Risks due to Earthquakes", as a contribution of referential input and representation model, for those scientific investigations that are carried out in the future. used as a consultation, to clarify the idea of how the designs can be, of the awareness processes, of the preparation process, in the modeling for recovery and rehabilitation and in the Reconstruction process, in disaster scenarios due to earthquakes.<sup>32</sup>

They can also be used and related in association with other research, whose purpose is to assess Cognitive Learning in cases of disasters due to floods, tidal waves, tsunamis and in those related to the use of Artificial Intelligence AI, with the use of ICTs, in the framework for addressing Disaster Risk Reduction, according to the Sendai Framework [2015-2030].<sup>33</sup>

## **III. CONCLUSIONS AND RECOMMENDATIONS**

- The research includes a methodological phase of reviewing the literature, such as statistical data and information on natural disasters caused by earthquakes considered chilling and deadly for society, and also inquire about advances in the prevention of disaster risk due to earthquakes, under the deconstructive and descriptive lens of the cognitive learning of human senses and sub-senses.
- The absence of the theme corresponding to the Prevention of Disaster Risks due to earthquakes has been

<sup>32</sup> (Mario, 2017)

<sup>33</sup> (SENDAI SMarco, 2014)

verified, to form a network of participation and involvement by the duly informed University Community, this void creates the option of deploying efforts to use Cognitive Learning using the senses and sub-senses.

- With the purpose of implementing disaster risk management in the UNMSM university institution, in cases of earthquakes an opportunity and window is opened to carry out and dedicate efforts to scientific research, in order to facilitate the integration and articulation of prevention and disaster risk reduction in the spaces and environments of the Dean University of America.
- In this context, the investigation of earthquake disaster risk prevention through Cognitive Learning in the house of studies, the researcher has managed to identify a group of first-level qualified senses, with a very high degree of importance and they integrate the sense perception of light, color, heat and hearing.
- During Phase 2, a second group of first-level qualified senses, with a high importance rating, has also been identified and is made up of the senses of touch, body balance and proprioception.
- In Phase 3 there is the association of the third group of senses and sub-senses, identified at the second level, with a high importance assessment, and it is made up of mechanoreception, kinesthesia and thermoception.
- In Phase 4, which comprises the final part, we have the fourth group of senses and sub-senses, identified at the second level with an assessment of medium importance, and it is made up of osmotic pressure and lung inflammation.
- The research for which we elaborated the "Design of Cognitive Learning by the Senses and Subsenses for the Prevention of Risks by Earthquakes, intends to contribute as a reference document and representation model, for those scientific investigations that can be achieved later [Prospective Management of the Disaster Risk], that is, in the immediate future, how can they be, the designs of the awareness processes, in the preparation process, in the modeling for recovery and rehabilitation and in the Reconstruction process, in earthquake disaster scenarios.
- They can also be used to associate it with research, the purpose of which is to assess Cognitive Learning in cases of disasters due to floods, tsunamis, Tsunamis and those related to the use of Artificial Intelligence and the use of ICTs, within the framework of addressing the Reduction of Disaster Risk, according to the Sendai Framework Agreement [2015-2030].

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