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Geodidactic proposal: Interactive digital infographics aimed at risk prevention for the civilian population

Propuesta geodidáctica: Infografías digitales interactivas orientadas a la prevención del riesgo para la población civil

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ABSTRACT

Currently, the risk prevention actions for natural phenomena carried out by the civil population are relevant for the life and should be promoted. A teaching material was developed and validated for the civil population consisting of interactive digital infographics (IDI) that include a series of multimedia resources. The IDIs were created under a social geographical approach to develop skills in prevention against four types of natural phenomena chosen for their high frequency and disastrous impact on Mexican territory: earthquakes, hurricanes, floods, and landslides. Additionally, a workshop directed at the civil population was designed and opened to evaluate the functionality of the educational material (IDI), and tools (rubrics and checklists) were created for assessing competencies (IEC) in the users of the educational material. Both the IDIs, the workshop, and the IECs were evaluated by three experts (geographers and a pedagogue) using Likert scales. Experts considered the infographics, the workshop, and the assessment tools for competency-based learning to be suitable.

Palabras clave:
Fenómenos naturales, prevención, infografías digitales interactivas, geografía del riesgo, geografía social.

RESUMEN

Hoy por hoy las acciones de prevención del riesgo por fenómenos naturales llevadas a cabo por la población civil, son relevantes para la vida y deben promoverse. Se elaboró y validó un material didáctico dirigido a la población civil consistente en infografías digitales interactivas (IDI) que incluyen una serie de recursos multimedia. Las IDI fueron creadas bajo un enfoque geográfico social, para desarrollar competencias en prevención del riesgo ante cuatro tipos de fenómenos naturales que se escogieron por su alta frecuencia e impacto desastroso en el territorio mexicano: sismos, huracanes, inundaciones y deslave. Además, se diseñó y abrió un taller dirigido a la población civil para valorar la funcionalidad del material educativo (IDI), y se crearon

	instrumentos (rúbricas y listas de cotejo) de evaluación de competencias (IEC) en los usuarios del material educativo. Tanto las IDI, como el taller y los IEC, fueron evaluados por tres expertos (geógrafos y pedagoga) mediante escalas Likert. Los expertos consideraron las infografías, el taller y los instrumentos de evaluación del aprendizaje por competencias, como idóneos.

Introduction

According to the literature, preventive civil protection measures in response to disasters have been implemented primarily from the 20th century to the present, although records from ancient civilizations mention empirical preventive actions, for example, in Egypt with the construction of canals and dikes to control the Nile River; in China with systems of dams and dikes to prevent flooding of the Yellow River; and among the Incas with the use of terraces to prevent landslides and control erosion (Campanate, 2024). During Mexico's pre-Hispanic and colonial periods, hydraulic projects were carried out to protect residents from floods and hurricanes (Vargas, n.d.).

From the 16th to the 19th centuries, as scientific thought advanced, natural phenomena were studied and documented, and along with this, the beginnings of a more informed approach to disaster prevention emerged among nations. For example, in the United States, based on ongoing studies of tornadoes and cyclones in the Atlantic Ocean, an average of more than 1,000 tornadoes are recorded per year (Midwestern Regional Climate Center, n.d.). Likewise, England and France stand out in the field of climate observations and are pioneers in meteorology (Hontarrède, 1998).

Natural disasters can have a severe impact on the world's population. Among the largest disasters caused by natural phenomena, we can mention the earthquake with a magnitude of between 8.0 and 8.3 on the Richter scale in Shaanxi; this event occurred in China on January 23, 1556; It is considered one of the deadliest, with a death toll of 830,000 victims (ContraRéplica, 2024)

Similarly, a devastating earthquake struck Lisbon in 1755 with a magnitude of between 8.5 and 8.7; an estimated 70,000 people lost their lives, equivalent to 25% of the city's total population. Similarly, countries such as Spain, France, Morocco, and the United Kingdom suffered severe damage to their coastlines as a result of the tsunami (Cárdenas, 2025). Since that event, Europe has placed greater emphasis on earthquake-resistant construction; however, there are still no public policies in place focused on disaster prevention.

It was not until the 20th century that preventive measures were formalized, and, following a series of disastrous events, several countries began to focus their attention on developing systems for risk management and prevention. The formal concept of civil protection did not originate in 1949; it emerged globally in 1977 with the adoption of Additional Protocol I to the Geneva Conventions of August 12, 1949, which focuses on the protection of victims in cases of war and related situations, including the protection of the population against disasters, recovery, and survival. (International Committee of the Red Cross [ICRC], 2012, p. 31)

Among other important dates worth mentioning is the International Day for Natural Disaster Risk Reduction (IDNRR), observed on October 13 (El Economista, 2024); this event highlights the importance of education in preparing future generations for disasters. In this regard, the Sendai Framework emphasizes the need to prepare young people; according to its data, young people are among those most affected, and they would also be the first line of defense in terms of empowerment.

The following section provides a general overview of the theoretical framework and specialized literature surrounding the fundamental concepts presented here, which form the basis for this proposed educational material on the prevention of natural phenomena.

The Geography of Risk and Disaster from the Perspective of Critical Social Geography.

From the perspective of geographer Allan Lavell, whose work reached its peak at the beginning of this century, risk geography can be interpreted as a branch of geography that has attracted significant interest from the geographical community and related fields. It studies threats, hazards, risks, catastrophes, exposure, vulnerabilities, and disasters in relation to their spatial and territorial characteristics. The importance of this field lies in helping to identify and plan prevention strategies, develop land-use planning, and design policies to mitigate disasters and build resilience.

There are a number of conceptual terms within the field of risk geography that are defined and studied from different disciplinary perspectives, with varying interpretations—ranging from the religious view that sees natural disasters as a punishment to Marxist scientific perspectives that view them as the result of a social construct. They are reviewed immediately.

A hazard "is a process, phenomenon, or human activity that can cause loss of life, injury, or other health impacts, property damage, social and economic disruption, or environmental degradation" (United Nations Office for Disaster Risk Reduction [UNDRR], 2017, as cited in Shi, 2020, p. 426).

The concept of risk according to the geographer Calvo (1984, para. 15), is that "Geographically, risk is defined by the specific situation of a human group at a given point in time in relation to the conditions of its environment." Furthermore, risk is defined as the potential for harm arising from the presence of a vulnerable population (Hewitt, 1983).

One of the terms from antiquity that is still in use is "catastrophe," which "refers to a fateful event involving widespread destruction that disrupts the normal order of things" (Martínez, 2009, p. 243); in other words, it is a disaster with a significant impact on the human environment that requires time, money, and resources for the response and recovery phases.

Another term worth highlighting is "population exposure to risk from a geographic perspective"—that is, the location and distribution of risks, both spatially and temporally, as well as the presence of certain natural and material assets in an area that may be damaged by a natural phenomenon. (Shi, 2020, p. 427).

With regard to vulnerability, the International Strategy for Disaster Reduction (UNISDR, 2017, as cited in Domínguez, 2022, p. 21) defines it as the "social, economic, cultural, and physical conditions that determine the susceptibility of communities to experiencing the effects of threats posed by a disruptive phenomenon, whether natural or human-induced."

Regarding the concept of disaster among geographers, Blaikie et al. are particularly noteworthy. (1996) point out that a disaster arises from the reciprocal relationship between natural phenomena and social dynamics; it is a dialectic. These authors argue that social and economic processes, as well as unequal power relations, create vulnerabilities and inequities in the distribution of resources and access to them, which affect different contexts and individuals in different ways, thereby triggering disasters.

Mexico's territory and the natural phenomena with the greatest frequency and impact.

Now that we have provided a very general overview of how the concepts of "risk," "vulnerability," and "disaster" are defined, as well as the relationships among them as addressed in the literature within the field of geography and related disciplines, we will

focus specifically on Mexico and its territory to understand the frequency and intensity with which natural disasters have occurred in the country. The country is geographically located in a region characterized by a complex topography shaped by a combination of climatic factors; this geographical setting gives rise to various natural phenomena, including hurricanes, earthquakes, volcanic activity, mass movement processes, waterspouts, and phenomena such as El Niño and La Niña.

According to studies by Abeldaño and González in 2018, meteorological and hydrological disasters occurred most frequently. In this regard, the Documentary Report on the Most Significant Disasters from 1810 to 2010 by the National Center for Disaster Prevention (CENAPRED, 2013) in Mexico, and the academic study by geomorphologist Irasema Alcántara et al. (2019) found that the most frequent disasters are (a) earthquakes, (b) floods, (c) slope instability, and (d) tropical cyclones.

The historical context of Mexico's approach to disaster response is characterized by a reactive approach that focuses on emergencies rather than on prevention strategies. This perspective conceptualizes disasters as "natural" and inevitable events, leaving little that the government or the public can do.

Among the prominent geographers who advocate for a reactive approach to authority is Hewitt (1983), who notes that government institutions tend to focus solely on coordinating and responding to emergencies. From their perspective, this technocratic approach treats the disaster as an isolated and temporary event, which prevents addressing the structural conditions of poverty, exclusion, and poor urban planning that actually expose the population to risk.

This conceptualization of risk as a natural phenomenon fosters a sense of helplessness and passivity among the population in the face of disasters, rather than encouraging an active, preventive attitude. These assertions are based not only on Article 2, Section XXII, of the General Civil Protection Law (LGPC, 2012), but also on an empirical review of government actions and civil protection policies in Mexico.

Formal and non-formal education in Mexico on disaster risk reduction related to natural phenomena.

Although agencies such as the National Disaster Center (CENAPRED) and the National Civil Protection System (SINAPROC) (CENAPRED Documentation Department) in Mexico have worked to disseminate infographics aimed at the general public to help prevent disasters caused by natural phenomena—such as earthquakes, given that much of Mexico's territory is located in an earthquake-prone zone—the dissemination of these materials has not had the influence and impact it should have. Evidence of this lack of impact comes from interviews conducted by one of the authors of this article with a non-representative, random sample of people from certain boroughs of Mexico City with the highest incidence of earthquakes, primarily in the Cuauhtémoc borough.

We believe it is very important to raise awareness among the general public about their role as active individuals who can adopt preventive measures to save their own lives and those of others, rather than assuming a state of helplessness and passivity in the face of phenomena—whether natural or human-induced. This paper therefore presents educational materials designed to help the general public develop prevention strategies for the four natural phenomena that occur most frequently and have the most harmful effects in Mexico.

Although the Mexican government tends to respond to natural disasters reactively rather than preventively, and although the Mexican people do not have a deeply rooted

culture of prevention, Mexicans are recognized for their ability to respond to emergencies, distinguishing themselves through their teamwork and solidarity during the earthquakes of 1985 and 2017. The population's ability to respond is and has been significant; however, its organization still faces many challenges as the disaster progresses through its various phases.

With regard to the extent to which Mexico's civilian population is educated about risk prevention, formal education does include this aspect in its curricula, but not in a cross-curricular manner; rather, it is focused on subjects such as geography in K-12 education (e.g., Dettmer, 2002) and, in higher education, only within degree programs directly related to natural phenomena, such as the geosciences, engineering, and environmental studies (e.g., Camprubí et al., [2025]).

In the realm of public policy, government agencies such as CENAPRED and Civil Protection have been doing more work in this area, and the SEP and CENAPRED have joined forces to bring disaster prevention into the educational system—though more as a strategy than as an integral part of the cross-curricular school curriculum. However, the social construction of risk ("how much can I do as an individual to protect myself and others from the impact of natural phenomena") has not been uniformly internalized by the civilian population, with information gaps existing in sectors with lower levels of formal education and greater social vulnerability (e.g., Patiño, 2025). Thus, vulnerability due to a lack of disaster prevention and response measures remains a priority area.

A review of the literature on prevention education (both formal and non-formal) has sparked a particular interest in developing educational materials for the general public, consisting of interactive digital infographics (IDIs), given the limited development of such work on the creation of geodidactics outside of school settings with a focus on disaster prevention; similarly, these materials could serve as a reference or foundation for research projects related to prevention.

The interactive digital infographics (IDI) were developed based on the TPACK model (Trigueros and Moreno, 2018, pp. 149, 150). The overall purpose of developing this educational material is to help the civilian population develop disaster preparedness skills through teaching methods adapted to real, context-specific situations.

From the perspective of critical geography, it is important to argue that risk is not merely a natural event; within this discipline, it is conceptualized as the result of a social construction. This material draws on the psychology of learning, the subjective perception of danger, and Edgar Morin's concept of complex thought. The latter approach is used to understand risk as a phenomenon interconnected with socio-environmental factors, uncertainty, and chaos. In general, the proposal focuses on reducing social vulnerability so that people can identify threats and develop their own disaster prevention strategies.

IDIs, or interactive digital infographics, are intended for non-geographers; they represent a form of geo-pedagogy—as mentioned earlier—that takes place outside of school and presents a challenge. Some of the goals they aim to achieve include helping people develop both strategies and attitudes. In terms of attitudes, the goal is for the civilian population to appreciate the basic principles of risk prevention and identification, to become aware of the causes and consequences of disasters, and thus to be concerned about their scope but, above all, about the importance of knowing how to prevent disasters and mitigate their impact.

For the purposes of this proposal, the educational material is conceived as an effective teaching tool that incorporates visual elements, text, images, and data, designed

in an engaging, interactive, and educational manner to help users quickly and concisely understand information on complex topics.

Thus, an Interactive Digital Infographic can be defined as: A digital visual resource that organizes and presents information using words and visual elements in a clear and engaging way, incorporating interactive features—such as clicks, animations, scrolling, filters, and buttons—so that users can explore the data in a dynamic and personalized way. It's digital because it's displayed on screens (web, apps, presentations). It is visual because it combines text, graphics, icons, illustrations, maps, etc. It is interactive because it allows the user to actively participate (discover layers of information, play content, open windows, etc.). All of these features make it easier to understand complex topics by providing a more engaging and nonlinear experience.

Therefore, the ultimate goal of this project is to propose interactive digital infographics aimed at preventing risks to the civilian population in Mexico. The goal is to provide adult citizens with access to digital tools that explain the causes and mitigation strategies for natural phenomena that can lead to disasters.

The proposed educational model, along with sharing experiences, developing family plans, preparing emergency kits, and participating in drills, are the types of activities we want the civilian population to implement to protect themselves. Making informed decisions and developing the plan promote organization and teamwork, reduce social vulnerability, and strengthen community resilience.

Method

This study follows the logic of an intervention-based research study. During the research phase, which was descriptive in nature, a survey (consisting of closed-ended and open-ended questions) was developed to gather information on the prevention skills possessed by the target population of the intervention. The results helped shape both the educational materials and the workshop designed to validate them. The goal was to evaluate how effective the educational materials are and, at the same time, to assess the impact of an intervention aimed at developing prevention skills among the general public.

Procedure for Developing and Evaluating Educational Materials

What does the educational material on disaster prevention caused by natural phenomena consist of? The educational material consists of a series of four interactive digital infographics (IDIs) designed to help prevent and mitigate disasters caused by earthquakes, hurricanes, floods, and landslides. They are intended for civilians with the following characteristics: Adults with internet access and basic knowledge of how to use digital and multimedia tools (video, audio, text, interactivity, and linear and nonlinear navigation).

What is the empirical evidence that led to the development of the educational material? The preventive educational materials—which were designed, developed, and evaluated—were based on information obtained through a diagnostic questionnaire administered in the field. The questionnaire included questions grounded in competency-based learning theory related to disaster prevention measures (knowledge and the application of skills in real-life situations—that is, preparing people to face current and future challenges). To develop the questions for this questionnaire, we drew on the field of perception geography—a subfield of geography that studies how people perceive, interpret, and experience the space around them, as well as their emotions, beliefs, and

experiences—that is, the way we perceive our surroundings and how this influences our behavior, mobility, sense of belonging, and sense of fear. This field offers a way to understand how risk is perceived and, through that understanding, to promote safer environments.

It is important to note that the emotional cross-cutting theme was taken into account in the design of the questionnaire; this theme is an essential component in reducing social vulnerability to disasters: psychological reactions to a disastrous event caused by a natural phenomenon perceived as a threat can manifest in various ways, such as sadness, fear of loss, feeling at a loss, anger, and other reactions. Addressing the expression of emotions in the questionnaire helps identify the need to develop teaching strategies to foster greater resilience.

The questionnaire includes demographic information such as gender, age, and level of education. It consisted of 10 questions, 8 of which were multiple-choice and 2 of which were open-ended. The questions focused on gathering the following information: how often they consider the possibility of facing a disaster in their environment; the skills they believe they need to develop to prepare; the usefulness of the civil protection education provided in school; their geographic location; media sources of information available in their context; the training they have received at various locations; the preventive measures they would take in the event of a disaster; the frequency of information in the mass media regarding forecasts; sharing their experiences with natural disasters; and offering suggestions for improving their own self-protection, as well as that of their loved ones and the community. The results of the questionnaire were essential for developing the proposed teaching materials.

Sampling criteria and sample size for the questionnaire. Among the criteria for administering the questionnaire to the civilian population, a non-probabilistic random sampling method was used in one of the municipalities with the highest seismic activity in Mexico City; the framework for civic competencies was consulted for its design, and basic education curricula related to the development of disaster response competencies were used as a reference. A total of 20 paper forms and 43 online forms via Google Forms were submitted, for a total of 63.

It is important to note that, since this was a geographically based sample, the questionnaire was administered at a strategic location to collect data in the field—that is, a geographic hub with high foot traffic and intersections of transportation routes, services, and shopping centers. Furthermore, based on its location, it was determined that this is where the strongest seismic activity originates at its epicenter. This refers to the Cuauhtémoc municipal government in Mexico City.

To promote this educational material, a blog titled “Interactive Infographics on Disasters in Mexico” was created; it can be accessed at the following address: https://infointeractiv.blogspot.com/ The blog features the four interactive digital infographics, the quiz, and simulations. Simulation Case Study: Mexico's Response to Disasters, Local Application of the Case Study, and an Escape Room. Get away: Adventures in Disaster Prevention. It is worth noting that escape rooms “are team-based live-action games in which players uncover clues, solve puzzles, and complete tasks in one or more rooms in order to escape within a limited time” (Nicholson, 2015, p. 1), and they are used to complement digital simulation games with the aim of fostering basic learning in civil protection. And finally, the questionnaire on perceptions of risk in the face of disasters caused by natural phenomena in Mexico City.

What are the theoretical foundations and the didactic and pedagogical aspects on which its design is based? The educational material was developed from the perspective of critical social geography and based on the concept of complex thought, as proposed by the philosopher and sociologist Morin (1999). The author highlights the importance of a multidisciplinary approach to disasters and risks posed by natural phenomena, one that brings together geographers, educators, and educational and social psychologists.

With regard to didactic and pedagogical aspects, a competency-based approach to learning was reinstated. Among the international definitions of competence, "it is defined as the development of complex abilities that enable students to think and act in various contexts." (UNESCO, as cited in Incháustegui, 2019, p. 58). From a constructivist approach to self-directed learning, competence is understood as the integration of conceptual, procedural, and attitudinal knowledge applied to risk management (understanding, decision-making, preparedness, and response). To this end, four interactive digital infographics and simulations were designed, focusing on the most common natural disasters in Mexico: earthquakes, floods, tropical cyclones, and slope instability. This material grounds instruction in digital interaction, positioning the user as the active protagonist of their own learning.

Since this is a digital and interactive resource, technology plays a key role as a tool that bridges the gap between the learner and the content to be learned. At this point, it is important to note that when using the instructional material independently, there will be no teacher or facilitator present—unlike in formal and non-formal educational settings—only the material itself, which must be as instructional as possible so that the individual can use it on their own. To achieve this, the TPACK model was used in the creation of the infographics. This model combines knowledge (K) of the content (CK, content knowledge)—that is, what is to be taught (the discipline)— pedagogical knowledge (PK), or how to teach it—pedagogy and competency-based learning—and technological knowledge (TK), or with what resources—technology: multimedia resources. Within CK, or content knowledge, the following methodological principles of geography were introduced: location, distribution, temporality, extent, comparison, relationship, and development. The field of risk geography and subtopics related to vulnerability, risk, and disasters; the distribution of the population in high-risk areas; risk management; and Mexico's geographical vulnerability to floods, hurricanes, landslides, and earthquakes.

Genially is one of the technologies that enable the interactive design of educational-technological experiences for users. The IDIs were conducted there.

Validation of instructional materials: Conducting a workshop on natural disaster prevention. To evaluate the effectiveness of the instructional material (Interactive Digital Infographics, IDI), a two-day synchronous online workshop was designed and conducted in a non-formal learning setting. The venue and publicity were primarily provided by the Center for Research and Higher Studies in Social Anthropology (CIESAS) in Mexico City, as part of its Permanent Seminar on Social Vulnerability.

The online workshop was designed to focus on sharing experiences and problem-solving within the framework of the knowledge society. That workshop resulted in low synchronous participation by the public. Thus, this low turnout is attributed to—and/or confirmed by—the perception that civil protection is the sole responsibility of the government. The session is now available in the CIESAS digital repository on Facebook. Given this low workshop attendance, it was decided to validate the proposal through expert evaluators from the UNAM (National Autonomous University of Mexico) and the

National Pedagogical University (UPN). The evaluators assessed the workshop from a pedagogical perspective using Likert scales, interactive tools (IDI and escape room), and rubric systems.

The peer review process met inclusion criteria based on high academic qualifications and a minimum of 15 years of experience. For the Risk and Geography area, Dr. José Francisco de León (Ph.D. in Applied Geosciences, UNAM) and Mtra. Sandra Cruz (high school teacher at UNAM who teaches geography). Likewise, the techno-pedagogical component was evaluated by Mtra. Itzamaray García, a specialist in educational development and an educator with a degree from the National Pedagogical University (UPN).

Results

Judges' Evaluation of the Workshop: The Likert scale for the assessment consists of 40 items rated on a scale of 1 to 5 (from "not at all" to "fully achieved"). The first section consists of 22 closed-ended items, one of which is an open-ended question; the second section has 9 closed-ended items; and the last section has 7 closed-ended items plus one open-ended question. At the end, you are asked to indicate whether you consider the workshop and the IDIs to be suitable or not. The following tables show the categories to be evaluated along with their indicators: 5 in the first section, 4 in the second, and 3 in the last.

Table 1
Evaluation of Workshop Components

Assessment Component and Criteria	*A*
1. Workshop Content	**4.40**
Teaching materials (IDI) increase knowledge	
Importance and Content of Educational Materials	
Detail and depth of the instructional material	
Clarity and understanding of images and graphics	
Multimedia Resources and Learning Experiences	
2. Methodology and Materials	**4.20**
Developing Practical Skills for Prevention	
Clarity of the examples	
Usefulness of Teaching Materials	
Structure and Organization of the Instructional Materials	
Adapting the Learning Method	
Easy access to the material and use	
Inclusion of hands-on activities (to reinforce concepts)	
Adapting Material for Other Contexts	
3. Practical Application and Relevance	**4.40**
Helps identify risks in the immediate surroundings	
Relevance of the Workshop to the Need and Objectives	

Applying What You've Learned to Your Immediate Environment	
4. Facilitation	**4.00**
Promotes collaboration and the sharing of experiences	
Clarity and Understanding of Objectives	
The facilitator's clarity in communication	
5. Logistics and General Evaluation	**4:30**
Workshop activities are useful and effective	
Overall satisfaction with the workshop	
Recommendations Regarding the Workshop	
Organizing the workshop in terms of schedule, resources, and logistics	

Note. *A* = Average. The criteria correspond to the aspects evaluated by the experts within each dimension of the workshop.

Evaluation of interactive digital infographics and simulations by judges. In addition, a couple of analytical rubrics were developed to evaluate the simulated activities in an escape room focused on disaster prevention, as well as for the reflection and analysis exercise based on the case study: Mexico's Situation in the Face of Disasters. Two judges—a geographer specializing in risk and an educator—participated in the IDI validation process. Both were sent a combination of a weighted checklist (assigning percentages to each evaluated indicator) and a rubric with four performance levels: basic, fair, good, and excellent. Individual preparedness and participation in disaster prevention are generally assessed using a competency-based approach. The judges evaluated these rubrics and checklists in four categories using the same five-point scale (1 = not achieved to 5 = fully achieved), based on the indicators shown in Table 2.

Table 2

Evaluation of IDI Categories and Simulations in an Escape Room

Category and indicators evaluated	***A***
1. Navigation and Usability	**4.50**
Uses and Navigation of IDIs	
Mental retention and ease of use	
2. Interactivity and Content	**4.40**
Ease and effectiveness in interacting with resources multimedia	
A variety of interactive content	
Clarity, Relevance, and Understanding	
3. Simulation and Practical Application	**4:30**
Realism and Accuracy of Simulations	
Skill Development and Decision-Making	
4. Visual Design	**4.60**
Attractive	

Note. A = average. The indicator data correspond to the aggregated qualitative assessment for each dimension. The overall average score was 4.40, which represents an excellent level of achievement. Created by the author.

Competency-Based Evaluation Rubric (REC). Assessment and comparison rubrics were developed to measure participants' level of knowledge and skills in the activities they were asked to perform. The socio-formative rubric assesses the level of skill with which the student implements a strategy to prepare for a disaster; the performance levels applied are pre-formal, receptive, problem-solving, autonomous, and strategic.

In the *preformal* stage, it has not yet been demonstrated that the participant's competence, knowledge, and/or skills are basic. In the *receptive* phase, the participant follows instructions, recognizes and applies knowledge and procedures with support. At the *problem-solving* level, the participant can solve problems and apply knowledge and skills in various situations independently, but still needs guidance. The *autonomous* individual solves problems and makes decisions without guidance or dependence; optimal application. In a *strategic* role, he solves problems and teaches others, innovates, leads, and proposes new approaches. One of the key advantages of using this type of level is that it helps determine the extent of the skills and autonomy that participants should develop.

Evaluation of the Competency-Based Assessment Tools (IEC) by Workshop Participants. The judges evaluated the competency-based learning assessment tools using eight indicators.

Table 3

Assessment of Competency-Based Assessment Tools Using a Likert Scale

IEC Evaluation Indicator	1	2	3	4	5
1. Is the observation guide and rubric easy to use?					
2. Does the guide make it easier to collect data during observation/assessment?					
3. Is the method used to evaluate the criteria consistent?					
4. Is the structure of the IECs organized and easy to understand?					
5. Are the IECs aligned with the learning objectives?					
6. Have the objectives of the IECs been defined?					
7. Does the socio-formative rubric promote reflection on learning?					

8. Additional Comments (Positive Aspects and Areas for Improvement in the Workshop)	—	—	—	–	—

Note. Likert scale response options: 1 = *Strongly disagree* to 5 = *Strongly agree*. The overall average score was 4.70, which indicates that the Competency-Based Assessment Instrument (IEC) performs at a high level on each of the seven indicators. Compiled by the author based on data collected during the workshop.

Although the judges determined that Taller, IDI, and IEC are suitable, they also emphasized the importance of improving certain aspects of the material, such as adding links to official, permanent websites, providing more up-to-date maps, and encouraging reflection during the workshop with participants regarding different ways of viewing the disaster and how it manifests in their environment.

The blended approach is implemented across the board. Questionnaires, a Likert scale, observation, rubrics, and a literature review played strategic roles in each phase. The data processing is final and sufficient. Changing the variables would affect the findings and reduce the proposal's applicability. Explanatory simplicity ensures clarity, and this eclectic structure precisely meets the objectives.

Discussion and Conclusions

In contrast to the static infographics used in the government sector, four interactive digital infographics were created for disaster prevention in non-formal settings. They were designed using multimodal resources and the TPACK model, which integrates the competencies of knowledge, skills, and attitudes to promote self-protection. The material was validated by experts and tested in a workshop at CIESAS. The approach taken in this work is based on a flexible and participatory pedagogy, as highlighted by authors Henry Giroux and Peter McLaren—both of whom were active in the late 20th century—who adapt educational content to real-world contexts in order to promote learning among people outside of school.

Twenty people registered for the workshop, but only three attended. The paradox is that, even though people acknowledge (based on information gathered from interviews conducted outside City Hall offices in Mexico City) that the government should provide more information and education on disaster prevention, in reality they either don’t have time or aren’t interested in receiving such training. In light of this result, the following question arises for future research: How can we motivate the general public to take a more active role in disaster prevention, rather than leaving disaster response solely in the hands of the government? This is an issue that deserves to be addressed and given careful consideration. The preventive educational material that was designed, developed, and evaluated consisted of a set of four interactive digital infographics (IDI). These IDIs were developed based on information obtained through a diagnostic questionnaire administered in the field, which included questions grounded in competency-based learning theory related to disaster prevention measures (knowledge and the application of skills in real-life situations—that is, preparing people to face current and future challenges).

How can I foster disaster prevention awareness among the civilian population? This is precisely one suggestion for how to generate it. In short, based on the reviews,

experience, and fieldwork conducted from this perspective, it is argued that the disaster is the result of a social construct.

The IDIs were validated by experts in educational technology and risk geography, who agree that they are suitable for promoting self-protection through digital skills. It should be noted that this proposal is not intended to remain merely a teaching resource; rather, it is intended to be integrated into land-use planning policies, specifically in the areas of planning and citizen participation.

From the perspective of complex thinking, digital civil protection requires social equity. Therefore, the IDIs and escape room were optimized for low-end devices and limited connectivity through simple code, low data consumption, and screen readers, thereby reducing structural vulnerability. Furthermore, given technological obsolescence, a sustainability protocol is needed for the blog. The design uses low-maintenance links to update the IDIs; it is essential to partner with an institution that can guarantee long-term technical support.

Finally, it is important to emphasize that the population surveyed believes there is not enough information available: they are requesting courses and workshops at their schools and workplaces because they do not have time to attend in-person sessions; they are also requesting more information—both in print and online—about the actions they should take during the different phases of a disaster.

Given this context, the proposal is to reconfigure the workshop in the future as an asynchronous, self-directed virtual learning environment based on microlearning through social-digital platforms. This proposal aims to democratize access, allowing citizens to engage with IDIs through a framework that offers flexibility in terms of time and self-directed learning.

In this regard, the IDIs have been posted on a blog, and we hope the public will visit the site and review this educational material. The blog is called "Interactive Infographics on Disasters in Mexico" and can be found at the following address https://infointeractiv.blogspot.com/. It contains the four interactive digital infographics, the quiz, and the simulations. Simulation Case Study: Mexico's Response to Disasters, Local Application of the Case Study, and an Escape Room. Get away: Adventures in Disaster Prevention and the Questionnaire on Perceptions of Risk from Disasters Caused by Natural Phenomena in Mexico City.

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