

Education for Improving Resilience of Coastal Infrastructure: Developing an Interactive Learning Hub

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Abstract— *Local communities in Puerto Rico continue to face unprecedented social, environmental, and economic challenges that prevent them from rebuilding the infrastructure damaged by recent extreme natural events. The UPRM Coastal Resilience Center's (CRC) goal is to help educate the community by transferring state of practice knowledge to stakeholders (students, faculty, professionals, first responders, and workforce) through formal (curriculum, internships, student projects, undergraduate research) and informal (workshops, seminars, lectures, short courses, webinars) learning experiences. This paper focuses on the CRC goal of continuing to support the multi-hazard capacity building (MHCb) by developing a web-based interactive learning hub (IL-HUB).*

Keywords— *learning platform, educational modules, multi-hazards, resiliency, coastal infrastructure*

I. INTRODUCTION (HEADING 1)

Local communities in Puerto Rico continue to face unprecedented social, environmental, and economic challenges that prevent them from rebuilding the infrastructure damaged by recent extreme natural events[1]. These communities continue lacking sustainable and resilient critical infrastructures (e.g., housing, water, access to reliable and cost effective power supply, appropriate and safe roads and accesses, reliable natural or built drainage systems, communication network, etc.) which are subjected to continuous natural hazards like hurricanes (winds, torrential rainfall, erosion, riverine and urban floods, nuisance floods, landslides), earthquakes (tsunamis, landslides, soil liquefaction), coastal floods (waves, hurricane storm surge, winter swells, astronomical tides), and droughts that result in risks of property and life losses[2][3][4]. Due to the slow reconstruction process in Puerto Rico, most of the critical infrastructure continues to be extremely deteriorated, was built with outdated codes and regulations and is poorly maintained. There are many structures that were informally built or were built with outdated codes and regulations which do not comply with current engineering standards. Puerto Rico's 2018 building code represents a significant revision from earlier versions[5] addressed the risks that communities in Puerto Rico are exposed to. Forty-four municipalities, including most of the major cities, are in coastal areas. The rest are in steep lands, exposed to landslides, soil instabilities, erosion, and excessive humidity. The whole Island is exposed to extreme earthquakes. Nearly half a million people live in flood prone zones. Geotechnical challenges are frequently encountered. Most recently widespread fires also aggravated the state of the natural ecology which affect runoff and flooding potential.

The UPRM Coastal Resilience Center's (CRC) goal is to help educate the community by transferring state of practice knowledge to stakeholders (students, faculty, professionals, first responders, and workforce) through formal (curriculum, internships, student projects, undergraduate research) and informal (workshops, seminars, lectures, short courses, webinars) learning experiences. It serves as a vehicle to engage the community to understand and learn its members' roles and responsibilities in providing resilient coastal infrastructure systems. CRC helps the community better understand various stages in coastal infrastructure hazard prevention, preparedness, response, recovery, and mitigation. The focus is on understanding the natural phenomenology, the engineering methodologies to address the level of risk the infrastructure is exposed to, the engineering methodologies and technology to analyse and predict the level of resistance and vulnerability the infrastructure and community is exposed to, the sustainable and resilient alternatives available at the state of practice or state of art to cope with risks and vulnerabilities. The project helps motivate students and faculty which creates pipelines of students and professionals into coastal resilient infrastructure careers and practice. This paper focuses on the CRC Year 7 goal of continuing to support the multi-hazard capacity building (MHCb) by developing a web-based interactive learning hub (IL-HUB).

II. INTERACTIVE LEARNING HUB (IL-HUB)

The COVID-19 pandemic has forced us to move all our Center's training from in-person to virtual offering. Providing virtual training has had a positive impact on the number of participants that we can reach due to the benefits to participants of virtual training such as flexibility, lack of travel costs, and increased accessibility. The goal of developing the IL-HUB is to have one place for all the courses, webinars, seminars, workshops, and other materials that we currently have and will continue to develop. The IL-HUB has also helped identify and access other websites and initiatives that can support our stakeholders to find solutions to their problems. The IL-HUB is accessed through individual password protected accounts which allow participants to watch and participate in interactive presentations, complete quizzes to assess learning and track training hours. The IL-HUB automatically issues certificates based on contact-hours achieved. This IL-HUB contributes to institutionalizing the long-term permanence of operational activities and leadership on capacity building at our institution which supports many other initiatives within and outside the university. It is envisioned that the IL-HUB will contribute to

position our institution as a leader in multi-hazard education, capacity building, and workforce development.

The IL-HUB serves as a mechanism to preserve, store, and retrieve the learning materials the project has gathered, produced, provided, accessed, or identified as relevant. It is available to our partners as a reference site which serves as an engine to facilitate access to readily available information. The first level of education at the CRC was to provide direct in-person instruction including classroom classes, “conversatories” (panels), workshops, conferences, and lectures. The second level of education added web-based information and remote instruction/learning experiences which included webinars and courses. The third level of education (IL-HUB) aims to automate teaching/learning activities. This provides flexibility, better accessibility, continuity to the center’s learning activities, commodity to our constituencies and increased institutionalization. It also helps expand the number of participants and institutions that may have access at any time to the Center activities. Table 1 shows the description of various levels of educational stages focused at CRC.

TABLE I
CRC LEVELS OF EDUCATION

Level	Description
1	Provide direct in-person instruction
2	Web-based information and remote instruction/learning experiences
3	IL-HUB

The IL-HUB runs on Moodle, an open-source learning management system. To use the platform, users must create an account and login (see figure 1). After logging in, users can see a menu of courses that allows them to select the course that they are interested in taking (see figure 2). Figure 3 shows a sample course and figure 4 shows the interactive component, where participants are asked to answer questions throughout the presentation to be able to continue watching the webinar.

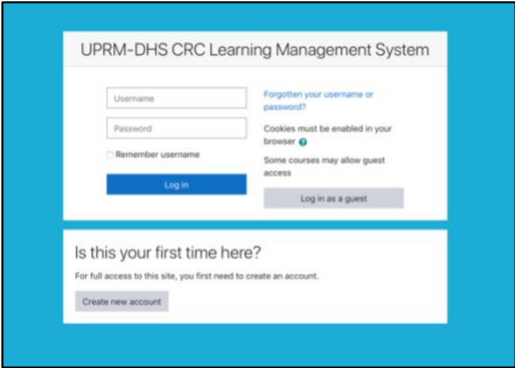


Fig. 1 IL-HUB log in

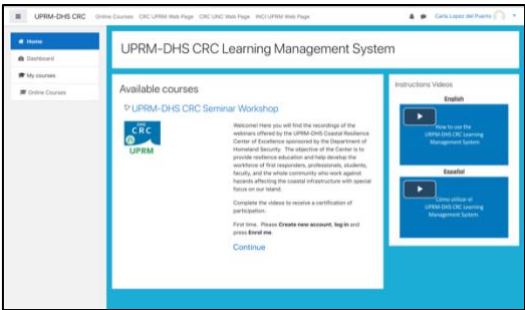


Fig. 2 IL-HUB available courses

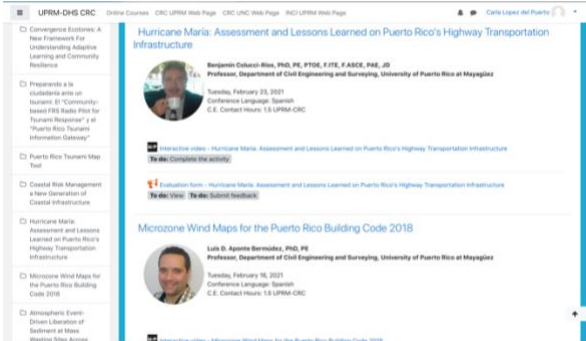


Fig. 3 IL-HUB sample courses

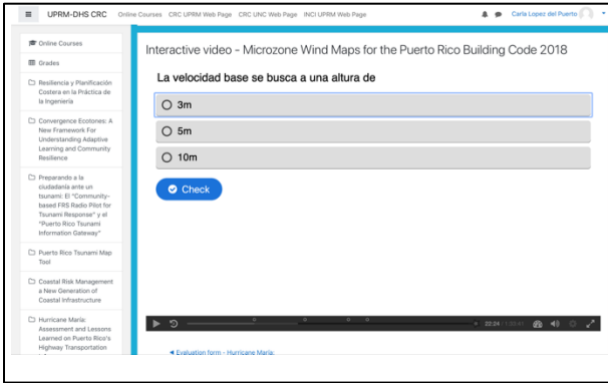


Fig. 4 IL-HUB sample interactive question

To date, the IL-HUB has 14 modules that vary in length between 1.5. and 3 contact hours. The topics which reflect relevant and priority topics for the community. Sample titles of webinars offered are shown in table 2.

TABLE II
SAMPLE WEBINARS AVAILABLE IN IL-HUB

Webinar Title
Web-based information and remote instruction/learning experiences
Convergence Ecotones: A New Framework for Understanding Adaptive Learning and Community Resilience
Puerto Rico Tsunami Map Tool
Coastal Risk Management a New Generation of Coastal Infrastructure
Hurricane María: Assessment and Lessons Learned on Puerto Rico's Highway Transportation Infrastructure
Microzone Wind Maps for the Puerto Rico Building Code 2018
Compound Inundation: Puerto Rico vs. Louisiana
Resilient Design of Coastal Structures

III. CONCLUSIONS

The COVID-19 pandemic has changed the way in which we deliver education at different levels (K-12 outreach, formal university levels and postgraduate continued education). One of the advantages of online webinars is increased participation due to the ability of participants to attend the webinars from outside the university. The development of the IL-HUB has allowed us to create a repository of webinars and information that can be accessed asynchronously and can automatically track participants' contact hours and issue certificates of completion. Therefore, it contributed towards our institutional efforts to become a reliable source in multi-hazard education, capacity building, and workforce development. With this effort, we are expanding the capacity to reach to the community and professionals outside of our physical boundaries in a more permanent and effective way.

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