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Design Principles at the Core: Shaping Volcanic Risk Education for Resilient Communities

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Abstract

Chile's dramatic geography, characterized by the Andean mountain range, is home to over 2,000 volcanic vents, including 87 that are active, making it one of the most volcanically vibrant regions in the world. This natural phenomenon presents both a majestic display of Earth's power and a considerable challenge in terms of geological hazards. The Villarrica volcano (Rukapillan in Mapuche language), noted for its high activity levels, demonstrates the ongoing need for local communities and government agencies to engage in proactive risk management and emergency preparedness to mitigate the impacts of potential eruptions. This calls for innovative approaches to education and community engagement, aimed at enhancing public understanding and safety regarding volcanic activity.

In this context, the Centro Interactivo Vulcanológico de la Araucanía (CIVUR-39º), initiated by the Universidad de La Frontera (UFRO), represents a pioneering effort to harness the power of citizen science, interdisciplinary collaboration, and a blend of Western and Mapuche indigenous knowledge systems to democratize scientific knowledge. Located in Pucón near the Villarrica volcano, CIVUR is strategically placed to serve as a vital educational resource, addressing the unique challenges faced by the local community and tourist visitors to make complex scientific concepts accessible and engaging to a broad audience. The main aim of CIVUR is to bridge the gap between scientific research and public awareness, thereby enhancing community preparedness and resilience in the face of volcanic hazards.

Employing a Design-Based Research methodology (McKenney & Reeves, 2012) alongside Activity Theory (Engeström, 1987) to tailor educational technology to the distinct needs and characteristics of local settings (Aguayo, 2015), our proposed research focuses on a specific inquiry: examining the transferability and possible implementation of key design principles coming from Auckland University of Technology's AppLab in Aotearoa New Zealand to the Chilean setting of CIVUR, including: design of virtual and mixed reality (XR) learning environments for free-choice and self-determined learning (Aguayo & Eames, 2023; Aguayo, Eames & Cochrane, 2020; Cochrane et al., 2017; Eames & Aguayo, 2020; Jowsey & Aguayo, 2017); online community education, partnerships and digital citizen science (Aguayo & Decima, 2022; Aguayo & Eames, 2017a, 2017b); ethical enactive and inclusive STEAM design (Aguayo et al., 2023; Videla, Aguayo & Veloz, 2021); culturally-responsive practice in digital innovation (Aiello et al., 2021; Smith-Harvey & Aguayo, 2022); and organic immersive learning design (Aguayo, 2023).

Key elements of this research not only touch on digital innovation for volcanic risk education and resilience, but also on embracing and including local Mapuche indigenous worldviews, introducing a rich layer of cultural depth and contextual knowledge to the educational content. Integrating these perspectives is crucial for creating learning interventions that are not only scientifically rigorous but also deeply rooted in the local cultural heritage. By leveraging the latest advancements in educational technology theory and practice, CIVUR has the potential to pioneer new methodologies for engaging school students and the broader community in meaningful learning experiences about volcanology and risk management. This exploration will include an analysis of how digital tools can be designed and implemented to support interactive learning, scientific reasoning, and the application of cultural knowledge in real-world settings. Ultimately, the research aims to offer a model for integrating digital innovations with culturally responsive teaching practices that can be applied globally, enhancing educational outcomes and empowering communities to better understand and respond to the natural world around them.

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