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Bibliometric Analysis of Earthquake Technologies in Physics Education for Education for Sustainable Development

Hanan Zaki Alhusni[1], Binar Kurnia Prahani[1], Titin Sunarti[1], Madlazim[1], Salma Hasna Hamiyda[2]

[1]Universitas Negeri Surabaya, Surabaya, Indonesia
[2]Al-Azhar University, Cairo, Egypt

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ABSTRACT

Objective: *This study aims to explore the intersection of earthquake technologies, physics education, and Education for Sustainable Development (ESD) through bibliometric analysis. The objectives include mapping the existing literature, identifying key trends, gaps, and influential publications, and highlighting the contributions of top authors and geographical hotspots in this interdisciplinary field.* ***Method:*** *A comprehensive bibliometric analysis was conducted using publications from 2021 to 2025, sourced from databases like Scopus. Keywords related to earthquake technologies, physics education, and ESD were employed to gather articles. The study utilized tools like VOSviewer and Bibliometrix for citation analysis, co-authorship patterns, and thematic evolution, allowing for the identification of key research trends and collaborations.* ***Results:*** *The analysis reveals a growing body of research, particularly in Asia, with a focus on specific technologies like virtual reality simulations and mobile applications for disaster preparedness. However, the study also highlights a fragmentation in the field, with limited holistic approaches that bridge these technologies and educational frameworks. The most influential authors include Deng X and Xu D, with significant contributions from countries like China, Indonesia, and Japan.* ***Novelty:*** *This study provides a unique bibliometric overview of the intersection between earthquake technologies, physics education, and ESD, a topic not extensively covered in recent literature. It offers new insights into the state of research, identifies key gaps, and lays the foundation for future research in integrating technological innovations into disaster preparedness and education for sustainable development.*

INTRODUCTION

The integration of physics education and sustainable development has become an essential component in preparing future generations to respond effectively to natural disasters (UNESCO, 2017; Langa et al., 2019). The hope is that advancements in educational technologies can facilitate this integration, specifically in the context of earthquake preparedness (Wang et al., 2018; Müller et al., 2020; O'Neill et al., 2021; Lawrence & Smith, 2022). By leveraging technologies such as virtual reality (VR) simulations and mobile applications for earthquake response, students can not only grasp the fundamental physics behind seismic activities but also develop the skills necessary for sustainable disaster risk management (González & Lee, 2017; Zhang & Li, 2019; Tanaka et al., 2020; Liu et al., 2021; Rojas et al., 2021; Zulhilmi et al., 2025; Tan & Tan, 2025; Masocha & Ntim, 2025). This approach is seen as a pivotal tool for promoting Education for Sustainable Development (ESD), with the potential to reshape how both physics and disaster risk reduction are taught globally (Shaw & Oikawa, 2014; Cabello et al., 2021; Parajuli, 2020; Oikawa & Shaw, 2014; Kurths et al., 2025)..

Recent studies have shown that educational technologies are being increasingly incorporated into disaster risk reduction (DRR) education, yet a significant gap remains in their application specifically within physics education for earthquake preparedness