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Virtual Laboratories in Civil Engineering: Joint Digital Platform & MSc Course Curriculum

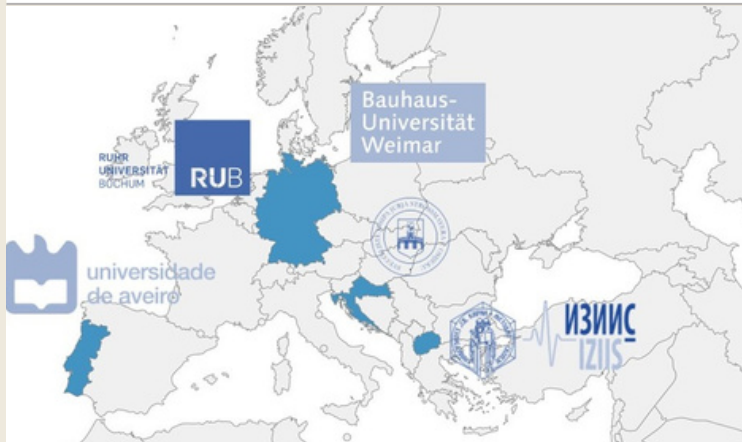
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As a pioneering initiative in civil engineering education, it combines virtual experimentation with academic outreach to overcome institutional limitations and enhance learning opportunities.



01. Introduction

The initiative develops a joint digital and VR lab platform to support collaborative international learning in civil engineering education. It applies innovative and participative teaching methods within the MSc curriculum and ensures inclusive access to virtual experiments that overcome physical and social barriers. Using immersive technologies and online collaboration, it enhances digital skills while promoting internationalization, blended mobility, and interdisciplinary, case-based learning.

02. Objective

Build an open-access VR lab that drives inclusive international e-learning and embeds case-based, blended mobility in a future-ready MSc.

Statement

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03. Methodology

Five European universities jointly developed a VR-based MSc course in civil engineering under the Erasmus+ PARFORCE initiative, featuring remote access to virtual wind, fire, and earthquake experiments.

6 ECTS (180 hrs), jointly taught across partner institutions
Piloted in 2022/23 and continued in 2024/25
Now open to external students via open-access VR labs

The blended course combines online lectures, group projects, short-term mobility, and training in data analysis, machine learning, and collaborative research.

04. Results/Findings

The initiative produced innovative teaching frameworks and VR tools that improved learning quality, digital skills, and accessibility while strengthening the long-term impact of higher education through transferable skills and international collaboration.

- **Outputs:** Instructional guide, pedagogical frameworks, VR learning tools
- **Outcomes:** Enhanced teaching quality, skill development, and accessibility
- **Impact:** Sustainable influence on higher education, transferable competencies, and global exposure

NOTE!

Success relied on dual evaluation (student feedback + ML), interactive mixed-reality learning, and remote monitoring for cross-institutional engagement, while challenges included refining questionnaires and aligning curricula across different credit systems.



05. Analysis

The platform features 3D VR simulations of complex and high-risk civil engineering experiments, captured through high-end video systems and consumer cameras under controlled lighting for full 3D scene acquisition. Immersive learning is enabled through VR headsets and interactive setups integrated with Moodle modules, tests, and collaborative tools for digital course delivery.



Students in the VR classroom (left)



Recording a laboratory experiment for the VR classroom

06. Conclusion

Virtual lab setups and open-access VR tools can be reused and adapted across institutions and disciplines, extending the impact beyond civil engineering. The blended learning model promotes inclusion, equal opportunities, and flexible participation in line with the UN Agenda 2030 goals. Overall, the initiative strengthens the global competitiveness of HE through sustainable, digital, and internationally connected curricula.

