

INTEGRATION OF VIRTUAL REALITY INTO CHEMICAL ENGINEERING EDUCATION

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Chemical engineering is a multidisciplinary, experiment-driven field of study that plays a crucial role in addressing the needs of modern industry, developing energy-efficient technologies, and protecting the environment. Its development is strongly linked to a practical understanding of complex chemical and process systems. However, education in this field is often constrained by high operational costs, long reaction times, safety concerns, and limited access to large-scale industrial installations. Therefore, education in chemical engineering frequently relies heavily on theoretical instruction, while students have limited opportunities to interact with real industrial equipment or processes. This often prevents students from gaining direct hands-on experience. This gap between theory and practice may hinder the development of students' practical engineering competencies [1].

Recent technological progress and the digital transformation of higher education, accelerated by the COVID-19 pandemic, have fostered the integration of advanced information and communication technologies into teaching and learning. Among them, virtual reality (VR) has gained attention as a tool for interactive, immersive, and experience-based education.

The abstract refers to the project “*Innovative Integration of Virtual Reality in Chemical Engineering Education*,” implemented under the Erasmus+ Programme KA220-HED 2024 action – Cooperation Partnerships in Higher Education. The project addresses the challenge of effectively implementing virtual reality technologies in the teaching process and explores how VR-based learning environments can support a more effective and engaging approach to chemical engineering education. By developing and applying innovative digital solutions, the project aims to bridge the

gap between theoretical knowledge and practical understanding, thereby improving students' learning outcomes and professional competencies.

Within the project framework, particular emphasis is placed on developing an inter-university VR platform for chemical engineering education. The platform will serve as an open repository for VR applications, simulations, and learning materials created by project partners. It will enable students and educators to access immersive simulations of chemical installations, explore 3D models of industrial equipment, and interact with virtual environments replicating real industrial scenarios. The platform also supports collaborative learning through shared virtual spaces where users can perform tasks, explore installations, and engage in problem-solving activities. The applications were developed, among others, using Unity, SimLab VR Studio, and AutoCAD Plant 3D, and were thoroughly tested and optimized for the Oculus Quest 3 headset (Fig. 1).



Fig. 1. Representative screenshots of the developed VR applications

In addition, the project involves the development of methodological guidelines and training materials for, among others, students and academic staff to support the effective integration of VR technologies into university curricula [2]. The initiative addresses both technological and pedagogical aspects of VR implementation.

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