Developing a Framework for Industry-Relevant, Research-Based Case Studies in Chemical Engineering Education

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Highlights

- HE framework for industry-relevant case studies was designed
- Case studies were realized
- Digital tools were developed for HE teaching.

1. Introduction

InnoLAB (Innovative Learning Across the Borders) is a Cooperation Partnership Erasmus+ project dedicated to bridging the gap between academic teaching and the rapidly evolving industrial landscape, particularly in the context of energy transition, environmental challenges and digital transformation.

In an era of rapid technological advancement, keeping course contents in advanced engineering subjects aligned with industry developments is increasingly challenging [1]. While fundamental principles remain essential, there is a growing need to ensure that students are equipped with the latest knowledge and skills to address emerging challenges effectively [2]. Students must acquire problem-solving skills, creativity, ability to work in diverse teams and to collaborate remotely. These are essential competences, as outlined in the Bologna Process, requiring a shift away from content-based learning toward competence-based, student-centered education [3].

2. Methods

All case studies were developed using MATLAB LiveScripts and/or DWSim simulations, softwares used either as widespread in academia or as free open source.

3. Results and discussion

To address these challenges, InnoLAB develops industry-driven, research-based process case studies that integrate recent advancements in chemical engineering. Firstly, the collaboration of academic and industrial experts ensures that the developed case studies are aligned with real-world industrial needs. Afterwards, didactics experts and lecturers are involved in crafting didactical materials to guide students through these case studies. At a later stage, the developed material is tested in in-person settings and refined to include the students' feedback. Finally, the material is adapted to facilitate collaborative, cross-border group work in a digital environment. Figure 1 summarizes the main project events and work packages.

Figure 1. Overview of the main activities and work packages in the InnoLAB project.

During the first project event, called the Experts School, eight processes crucial to the energy transition are selected for developing case studies. In class, students will be asked to propose potential improvements to the processes in terms of safety, resource efficiency, process intensification, digitalization and sustainability. Each case study includes an interactive process simulation, allowing students to adjust operating conditions and observe the effects of their decision-making. Proposed process modifications undergo life-cycle assessment and safety evaluation, requiring students to critically assess their feasibility and impact.

The developed user cases were further developed and discussed in the Teacher School, held in Turku (Finland) in the week 26-30 January 2026. The feedback of relevant experts and students lead to a further step in the development of the case studies that will one of the output of the project.

4. Conclusions

In this contribution, we present a structured framework for developing industry-relevant, research-based process case studies. As an example, we will show one case study, outlining its motivation, technical foundation, expert-identified improvement potential, interactive process model and expected learning outcomes.

References

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HE; Erasmus; digital skills.

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