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Flipped Classroom and AI tools in the Environmental and Process Technology course

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In the course *Environmental and Process Technology*, a mandatory first-year subject common to all industrial engineering degrees at the University of Valladolid, two structured activities have been designed and assessed: a seminar and a task. These activities pursue three main objectives: (1) to provide students with a fundamental understanding of key unitary separation operations used in process engineering; (2) to enable students to select appropriate unitary operations for pollutant removal or the recovery of valuable compounds; and (3) to develop shared study materials on unit operations.

The seminar was conducted using a flipped classroom methodology, supplemented by an in-person session (2 hours) in the computer lab. Prior to the in-class session, students worked in groups of four to research specific unit operations, including filtration, membrane processes, sedimentation, adsorption, absorption, and ion exchange. Each group was required to complete a structured template, provided by the instructor, summarizing key information on their assigned operation, including its objective and description, process flow diagram, involved phases, input and output streams, separation agent, and industrial and environmental applications.

To complete the template, students were encouraged to utilize Artificial Intelligence tools (e.g., ChatGPT, DeepSeek, Bing AI, Perplexity, Google Bard) while also being provided with technical literature to verify the accuracy of the gathered information. During the computer lab session, each group prepared a PowerPoint presentation on a unit operation assigned by the instructor (40 minutes). The presentation, limited to four slides, had to comprehensively address all aspects outlined in the template. Each group then delivered a 10-minute oral presentation, with participation from all members, followed by a discussion and Q&A session.

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