Área temática: T3. Aplicaciones informáticas en la docencia en Ingeniería Química

Development of an interactive online tool to improve the teaching-learning experience in experimental laboratories

Raúl Molina*, Beatriz Paredes, Alicia García, Antonio Martín, Fernando Martínez

(raul.molina@urjc.es)

Grupo de Ingeniería Química y Ambiental. Universidad Rey Juan Carlos, Departamento de Tecnología Química y Ambiental, ESCET, Tulipán sn, 28933, Mostoles, Madrid, Spain

Keyword: virtual laboratory; computer-based learning; experimental laboratory; fluid mechanic

Abstract

Demonstration activities in experimental laboratories are fundamental activities in Science and Engineering Degrees, in order to allow students to apply theoretical concepts in demonstration operation units and to acquire technical competencies. The traditional teaching tools for these activities are based on a digital or printed guide of the experimental demonstration with a brief introduction of the fundamentals, the description of the experimental set-up and operation procedure, and an outline of the calculations and results that are required for discussion and presentation of final report for evaluation. This traditional methodology poses some problems for new generations of engineering students. On one hand, the knowledge of the practice, handling, measurements to be taken, etc., are based on a completely theoretical manual. On the other hand, this manual or lab guide is in many cases unattractive, boring, and tedious for students, and it is not a usefulness and motivating element for student learning induction. Moreover, further problems arise from the large amount of information that students need to read during short lab-sessions and the fact of lacking important parts of the fundamentals of the demonstration practice. All these factors are normally slowing the students' curve learning, often restricting their learning to mere observation [1].

The FLUID-LABVIR platform (https://www.gid-simip.com/en/virtual-laboratory/) is an attempt to innovate in the experience of students who must carry out laboratory demonstrations, particularly in engineering and fluid mechanics subjects. This platform provides students with a tool (guide prepared as a website) adapted to the context of current electronic media, in a multi-platform web format (PC, mobile, tablet) in an iterative mode. This electronic platform will be able to provide the theoretical fundamentals and measurements for the performance of the demonstration practice, but also images, animations (to support fundamentals) and/or videos explaining the handling of the demonstration practice by specialized professors. This platform offers the opportunity to evaluate the influence of different operation conditions through an immersive simulator that reproduce the experimental installation and the handling devices that the students manipulate in the real demonstration practice in the lab. This platform would also give the opportunity to develop in the same virtual mode other demonstration activities that are not performed in the lab in those experimental set-ups for the limited schedule time of the demonstration practices. On the platform website, students can download or access the practice simulator via the MyApps platform of Rey Juan Carlos University. This simulator is accompanied by a short tutorial video showing how to use the simulator and the operation that they can virtually do to get measurements for application to their calculations. Currently, this electronic platform and simulator has been implemented for three demonstration practices: Head Drop in Pipes, Flow in Open Channel and Wind Tunnel.

This online tool was implemented during the course 2020/21 in the Fluid Engineering subject, belonging to the Degree in Industrial Organization Engineering and Degree in Industrial Electronic and Automatic Engineering. Its use was held in 2021/22, being also applied in the Degree in Energy Engineering. Thus, more than 200 students have used the platform in those periods. According to a survey passed to the students, they considered the web a good complement to the practical learning before using it in the laboratory, indicating that the web was more attractive to them than the traditional guide in electronic pdf format. The students highlighted that, although it is always preferable to carry out the experimental practice in person, the immersive simulator was a good tool for practice prior to tackle the experimental setup in the lab. The simulator reproduced the handling (stages, devices, etc.) of the experimental installation in a very acceptable way, and in some cases, they used the simulator to obtain additional data to prepare the final report of the practices. As result of this work and this experience, the interactive online tool FLUID-LABVIR will be offered as a complement to the traditional syllabus in the fluid mechanics and fluid engineering labs for subsequent academic years.

Literature

[1] Gautam, S., Qin, Z., Loh, K.C. Enhancing laboratory experience through e-lessons. Educ. Chem. Eng. 2016, 15, 19–22.