

Presentation of the PhD Thesis: “Fostering Experimental Competences Using Complementary Resources”

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Abstract

This is the presentation of the Natércia Maria Pereira Machado Lima's PhD Thesis entitled “Fostering Experimental Competences Using Complementary Resources”, which was developed within Education in the Knowledge Society of the University of Salamanca. This PhD Thesis was presented and defended on October 15th, 2020 in the Research Institute for Educational Sciences building at the University of Salamanca. The PhD Thesis received the maximum qualification of “Sobresaliente Cum Laude”.

The use of ICT in the academic context is a reality, in the world we live in. The young generation of students is digital native, being immersed in a virtual world during a considerable part of their day. This has an impact in their life, including on their education. In undergraduate engineering education laboratory classes are an integral part of its curriculum. These days, many laboratory classes combine traditional hands-on labs with online labs (remote and virtual labs) and several experimental resources. A “blended” or “hybrid” approach to experimental learning seems the most effective to (students') experimental learning and the development of competences. Still this technologically mediated resource affects the way students learn and, in the literature, there is still a lack of works, considering the characterization of didactical implementations using a “blended” or “hybrid” approach and its impact in students' learning and the way they construct their knowledge. In the Electric and Electronic Engineering topic and using the remote laboratory VISIR there are really very few works, reported in literature, describing some small scaled didactical experiments.

The problematic which motivated this work was the need to understand the impact of different didactical approaches using this methodology (simultaneous use of several experimental resources) has on students' academic results. Ultimately this work intends to contribute to fill a gap identified in the literature: *identify factors (including some eventual students' characteristics) which affect students' learning and engagement in the electric and electronic circuits topic using the remote lab VISIR along with other complementary resources.*

To accomplish this end, four research questions were posed, each of them taking into account a set of factors in a specific field of inquiry and its influence on students' results. The first research question approached the way the several experimental resources could be combined and its effect on students. The second dealt with the influence of the proposed VISIR tasks characteristics on students' results. The third tackled important teacher mediation traces that could be linked to better students' performance. And finally, the last research question investigates if there were students' characteristics that were more associated with good learning outcomes and engagement.

Considering the former objectives, it was chosen a multi-case study research methodology, using a mixed method approach, resorting mainly to questionnaire, interview, documental analysis and observation as data gathering methods, and statistical analysis (descriptive and inferential) and content analysis, as data analysis techniques.

A large-scale study analysis was conducted, including 26 courses (in a total of 43 didactical implementations using VISIR, as some of the courses have undergone more than one course implementation edition), comprising 1794 students and involving 52 different teachers. This study took place in several Higher Education Institutions (and at a minor extent, in some Technological and High Schools) in Argentina, Brazil and Portugal. In the southern hemisphere these didactical implementations happened in the 2016 and 2017 academic years while in the northern hemisphere it was possible to collect data from three semesters between 2016/17 and 2018/19 academic years. The study focused on analysing each didactical implementation (their characteristics, teachers' usage and perception) and the matching students' results (usage, academic results and perception). Ethical questions to guarantee both students' and teachers' privacy was taken care of, when using the data of the participants. The former data was only used

for the purposes of this study and the state of the participation was reflected anonymously, which can be observed both in the information collected for the analysis as well as in the transcripts along the text.

The study included the analysis of the collected data from various sources, the interpretation of its results using several analysis techniques, and the convergence in a process of triangulation. These results, after discussed with literature, allowed to answer in the most possible complete way the four research questions. Based on them, conclusions were drawn to identify factors that may foster students' learning and engagement.

The study also contributed to the advancement of knowledge in this research area. It allowed to conclude that VISIR and this methodology can be as useful for introductory courses as for more advanced ones (dealing with this thematic) as long as teachers plan the didactical implementation according to the type of course and students' background. Plus, this methodology based upon VISIR can be applied with high success to courses that do not have an experimental component, nor its contents are directly related to the Electricity and Electronics topic. In these courses VISIR can be used with the purpose of contextualization, providing more interesting and appealing learning environments (e.g. theoretical mathematical courses). Finally, both teachers' perception and students' results suggest VISIR target public seems to be the students that require more support in their learning, that is, the students still struggling with difficulties than the more proficient students.

Keywords

Engineering Education, curricular design, experimental practices, VISIR, simulations, hands-on labs, remote labs, teacher mediation, teacher reflection, students' learning, students' characteristics, students' engagement, didactical implementations.

Links to the documents

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