The VISIR+ Project – Helping Contextualize Math in an Engineering Course

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***Abstract*—The long-term goal of engineering education is to prepare students to work as engineers. Being a practical profession, laboratories play a crucial role in illustrating concepts and principles as well as improving technical skills. In the last decades the use of online resources (simulators and remote labs) has been growing, either as a complementary and/or as an alternative way of developing experimental competences. In the scope of the VISIR+ Project, this work presents the first results of a didactical implementation using simultaneously the remote laboratory VISIR (Virtual Instrument Systems in Reality), simulation and calculus in a Math Course at the Federal University of Santa Catarina (UFSC). The preliminary results indicate that the use of several resources increases students' performance, boosting their learning and competence development.**

Keywords— Remote Laboratory, VISIR, Computer Simulation, Competence Development, Learning and Teaching Strategies, Engineering Education

I. Introduction

Engineering higher education has undergone several innovations in the last decades, one of them being the use of Information and Communication Technology (ICT) tools. The use of virtual resources – remote labs and simulations – as a complementary and/or alternative learning tool to the traditional hands-on laboratories, allows students to develop experimental competences, which can play a different role in their importance for the engineering learning process [1], [2], [3]. Besides, the use of ICT tools may act as a stimulus for younger generations as they are digital natives [4]. Amongst these tools, one of the main instructional technologies adopted and valued in engineering education, are remote labs which are also, regarded as one of the major shifts in engineering education in the last 100 years [5].

The use of virtual resources presents several advantages: students can access the resources whenever, wherever and as many times they feel like, thus contributing to increase students' responsibility and autonomous work, supporting lifelong learning, etc. [3], [6], [7], [8]. Nevertheless, it is important for students to be aware that these resources provide different experimental results: well-behaved results from computational models for simulations and real experimental results for remote labs. Perhaps as a result of some intrinsic difficulties and availability of remote labs in certain domains, teachers are tending to use virtual resources more often, either substituting or complementing the traditional hands-on labs. Brinson [6] claims that a "blended" or "hybrid" approach to laboratory learning, that is a combination of hands-on labs and virtual labs, seems to be more effective than the use of just one of them. This is also supported by the conclusion that there is no significant difference in students' learning outcomes achievement in hands-on versus virtual labs [6]. However, virtual labs usage is still a step ahead from the didactic effort needed to maximize the potential of these tools.

The use of diversified methods, techniques and resources in education may allow teachers to reach more students, by helping them to overcome their difficulties more easily. It is believed that this is due to students' different learning styles [9], [10]. Still, more recently, some authors argue that learning styles are an *urban legend in* education and although there are individual differences amongst learners that should be considered, the emphasis should be on the characteristics they share. [11].

Teacher mediation in classroom also plays an important role in students' engagement in tasks [12]. In fact, there are some teacher mediation characteristics that foster it: giving authority to students and keeping the task challenging [13]. Still, from the beginning, the task should be clear to students – they must be aware of its purposes to know what they need to do to achieve an answer or solution.

This work describes how a teacher introduced virtual labs in a math course (calculus) in order to support students' visualization and experimentation of practical applications of differential equation solutions (in electrical circuits). This was an innovative approach since traditionally students start