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REMOTE AND VIRTUAL LABORATORY RESOURCES FOR GEOTECHNICAL AND GEOENVIROMENTAL ENGINEERING: AN INITIAL ANALYSIS

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An engineer is a professional par excellence with a multifaceted apprenticeship combining basic, engineering, specialty, and complementary sciences. The overall goal of engineering education is to prepare students to practice engineering and to deal with the forces and natural materials. Thus, from the earliest days of engineering education, instructional labs have been an essential part of undergraduate and, in some cases, graduate programs. Indeed, prior to the emphasis on engineering science, it could be said that most engineering instruction took place in the lab (Feisel & Rosa, 2005). Virtual Labs (VL) have become part of current teaching and learning, particularly in engineering. Their potential to aid students beyond their hands-on lab classes has been a matter of discussion in literature. A recent literature review concluded that the use of Non-traditional Labs (which include remote and virtual labs) has the same or even better effectiveness than Traditional Labs. VL are effectively used to enhance student's science process skill and can also be used as a medium for distant learning. In addition, VLs also show several advantages such as easy access anytime and anywhere, less costs required and provide flexibility for students to conduct experiments according to their respective ability levels and learning speeds (Usman et al., 2021). For instance, according to Al-Atroush (2020), over 205 VLs in 9 Engineering & Science disciplines, comprising about 1515 virtual experiments, are currently being accessed by more than 600,000 students. Despite that, none is an NTL for geotechnical engineering. Current degrees in Geotechnical and Geoenvironmental Engineering are positioned in a comprehensive learning that integrates the fields of Engineering Geosciences, Rock Mechanics, Soil Mechanics, Geological Resources and Environmental Geotechnics. The objective is to establish a solid scientific base in the field of engineering, to develop professional and applied research skills in the geotechnical fields of rock and earth masses, the survey and exploration of georesources, environmental geotechnics and geosciences engineering. As in other experimental based courses, lab experiments play an essential rule in some specific subjects namely rock mechanics, soil mechanics, etc. The need to perform characterization tests of rocks combined with the difficulty in getting test samples for its realization, made evident the urge of the implementation of a virtual teaching and learning methodology, although, a rock mechanics experimental lab, for instance, would be a challenge due to the complexity of procedures to be followed. Virtual experiments can be the solution once real experiments can be visualized or simulated by students without an additional infrastructural setup for conducting them. The only requirement needed to perform the experiments either virtually or remotely is a computer connected to the Internet (Al-Atroush, 2020). The initial steps towards the development of NTL for Geotechnical Engineering comprise: (1) an initial analysis of all hands-on experiments done in the degree; (2) mapping the learning goal(s) associated with each experiment against the 13 learning goals of instructional labs defined by Feisel & Rosa (2005); (3) mapping each of the 13 learning goals to each type of NTLs; and, finally, (4) checking the possibility of developing a non-traditional version of every experiment, according to the associated learning goal(s).This

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