Chapter 11
Changing the LAB Experience in Undergraduate Engineering:
How an Online Approach Can Improve Formative Assessment Practices and Learning

Ali Mohamed Habibi
University of Southern Queensland, Australia

Ann Dashwood
University of Southern Queensland, Australia

ABSTRACT

The use of technology to enhance formative assessment in higher education continues to be a challenge regardless of advances in digital capabilities; yet research has shown its potential regardless of discipline. In undergraduate electrical and electronic engineering, which is the discipline focus in this chapter, lab work is an area that can be enhanced in this way but with such an enhancement comes a change in pedagogy from the conventional approach of in-lab physical practical work conducted by the individual student alone or in a group with limited support to one of working collaboratively in remote access laboratories scattered far and wide through an online learning systems that provides access to laboratory infrastructure and learning environments through the internet. In a collaborative learning environment, students work together to solve problems and need to become involved in dialogue to achieve a common goal where they depend on and are accountable to each other. This chapter explores students' experience of a collaborative approach to lab work regarding mastery of the voltage division rule and its relevance to formative assessment using remote access laboratories that depend on technology and internet access. The implications for task design and formative assessment are discussed based on the results of interviews with participating students. The nature of change in pedagogical practice is highlighted as are the implications for the design of formative assessment and the need to work at the level of "feedback markers" that are able to feed forward to progress learning.

DOI: 10.4018/978-1-7998-0426-0.ch011

INTRODUCTION

This chapter focuses on an exploration of undergraduate electrical and electronic engineering students' experience of learning through laboratory work (LAB work) that involves a collaborative approach 'on-line' as opposed to the conventional approach of individualised hands-on, in-LAB, learning alone. With the advent of the Internet the essential learning that requires students to be physically in a laboratory, as in conventional practice, is now able to be simulated online through remote laboratories where students are able to access from any place, subject to a computer, relevant program and stable Internet connection (Baladoh, Elgamal & Abas, 2017; Gadzhunov & Nafalski, 2010). Conventional practices in-LAB have typically required on campus presence of students to work with the specific equipment under the supervision of university staff, and as Schkoda, Schweisinger, and Wagner (2012) found, in their trials, the development of detailed manuals and training sessions improved student satisfaction. They also considered that such LAB work may be attached to a course or be provided separately to be successfully completed independently of standard courses or subjects of learning. In such a traditional pedagogical approach, this has meant the use of laboratories where students work with equipment in isolation receiving mostly only a summative assessment of their performance. Since contemporary approaches to teaching and learning are underpinned by social constructivist theory that advocate experiential learning ofproject- and problem- based learning types, where there is opportunity for critical reflection and dialogue, it would seem imperative that the vital knowledge and skills such as those acquired through the in-Lab learning experience, are taught in this way. In addition, this dialogic approach has implications for both the pedagogy and the assessment practices (Dann, Dann, & O'Neill, 2018), in that it supports the need for ongoing formative assessment in its acknowledgment of learning as inquiry with the co-constructing of knowledge during the experience (Gagnon & Collay, Hattie & Timperly, 2007; 2006; Pea, 2004).

The LAB learning experiencetherefore emerges as an important component of learning in Science, Technology, Engineering and Mathematics (STEM) undergraduate higher education (Dittmar & Kahlcke, 2016; Feisel & Rosa, 2005), and the choice of pedagogy, and assessment of learning continues to be under scrutiny to make improvements (Corter, Esche, Chassapis, Ma, & Nickerson, 2011). To explore this learning context in more depth with regards to engaging students in a more dialogic experience, the chapter reports case study research into undergraduate electrical and electronic engineering students' perceptions of working collaboratively in remote laboratories, simulated learning experiences. It deals with the underpinning pedagogical theory base for cooperative and collaborative learning and its application, and discusses its relevance to how these kinds of laboratory learning experiences are able to provide timely, useful feedback for the purposes of formative assessment. Besides providing a review of the related literature, it seeks to draw out the strengths of this formative approach from the perspective of students.

The chapter objectives are to explore how the conventional approach to LAB work and its assessment for undergraduate students in mechanical engineering may be enhanced through the use of technology by (1) engaging students in collaborative learning and (2) examining how this changed pedagogical practice relates to formative assessment and learning from the perspective of students. The chapter highlights students' perceptions of the pedagogical change involved that required them to interact with peers and use technology-supported techniques in their goal to master the application of the voltage division ruler (Boylestad, 2015).