Chapter 5
Distance Learning in Chemical Engineering:
Past, Present, and Future

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ABSTRACT

Online teaching and learning opens up great opportunities, particularly in terms of widening access to education, but also poses important challenges related to delivery, student engagement, adapting contents, and ensuring reliability of assessment. Some of these challenges assume particular relevance in engineering degrees, due to their strong practical dimension, the connection to industrial practice, and the need for programme accreditation. This chapter focuses on the example of the Chemical Engineering Distance Learning degree at the University of Strathclyde, describing its decade-long transformation from a mainly correspondence-based course to a fully online programme. The main challenges faced by course directors and teaching staff are identified, and the response to those challenges is critically discussed. Finally, a reflection is presented on the future of distance learning programmes in the context of expected developments enabled by online technologies, artificial intelligence, and collection of rich datasets on learner engagement and development.

INTRODUCTION

Distance Learning (DL) has become increasingly popular in recent years, taking advantage of the global connectivity provided by the internet and the fast development of digital platforms. In the context of higher education (HE), the last decade has seen a rapid expansion in the number and variety of online courses offered (Sun & Chen, 2016). This model of teaching and learning opens up great opportunities, particularly in terms of widening access to HE, but also poses important challenges that need to be addressed. Among these, one can identify issues related to delivery (*e.g.,* is direct interaction important, and if so, how can this be effectively implemented?), engagement (*e.g.,* how to ensure that remote students regularly engage with the course material?), content (*e.g.,* if there are practical elements to the course, such as laboratory work, how will these be delivered?), and assessment (*e.g.,* how to ensure reliability of remote assessment exercises?). Furthermore, in the context of HE institutions, it is important to reflect upon how DL programmes can coexist or compete with traditional on-campus programmes. All of these issues are particularly pertinent for engineering courses, due to their strong practical component and the requirement for professional accreditation. Further relevant to HE (and other levels of education) as a whole is the future direction of DL/online delivery, with potential drivers including artificial intelligence/machine-learning based approaches, fuelled by large-scale harvesting of data on the behaviour and response of learners made possible by online teaching.

This chapter discusses the past, present and future of online chemical engineering degree programmes, focusing on the specific example of the Department of Chemical and Process Engineering (CPE) at the University of Strathclyde. The CPE Department first began delivering DL programmes as far back as 1992, when the Bachelor of Engineering (BEng) honours chemical engineering by DL was created at the request of local industry. Industry-based students originally worked through paper-based course materials, posting in their assignments, but they also attended block teaching sessions of up to 6 weeks per year, on campus. This blended model (Graham, Allen, & Ure, 2003) of correspondence-based DL remained unchanged until around 2010. This chapter focuses on the period since then: the transition to online learning, the issues faced by teaching staff and students, and the challenges and opportunities that the future might bring. We begin the chapter by identifying the issues and challenges faced during the transition to a fully online delivery mode, framing them in the context of previous studies. We then discuss how those challenges were addressed in the particular case of the University of Strathclyde, presented from the perspective of different members of staff, each with a distinct experiential view of online learning in chemical engineering. Finally, perspectives on the future of this DL engineering course, and online learning in general, are considered.

BACKGROUND

Chemical Engineering Programmes at the University of Strathclyde

Before delving into the challenges related with DL in chemical engineering, it is important to provide factual context regarding the specific case that this chapter will be focusing on, as well as the professional accreditation framework that applies to engineering degrees in UK universities. The University of Strathclyde is based in Glasgow, Scotland, and has a longstanding connection to engineering and technology, from its inception through its founder's desire to create a 'place of useful learning', to its evolution into

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