Chapter 1
Interdisciplinary Higher Education: Redesigning for Industry 4.0

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ABSTRACT

The Industry 4.0 vision entails collaborations between technology specialists and industrial experts who are adept at integrating their specialized knowledge and disciplinary expertise. Preparing graduates for their future involvement in such interdisciplinary collaborations requires educators to design and implement interdisciplinary teaching in higher education. In order to foster students’ engagement in interdisciplinary learning, a meaningful understanding of how interdisciplinary learning actually occurs in interdisciplinary workplace is essential. This chapter provides a useful description of, and explanation for, interdisciplinary learning that are based on a multi-case study of three completed interdisciplinary projects.

INTRODUCTION

Our industrial system is experiencing a transformation that has been known as the Fourth Industrial Revolution (4IR). This industrial revolution has been enabled by an unprecedented confluence of several technological breakthroughs, most notably, by the Internet-of-Things, Machine-to-Machine communications, 3-D printing, autonomous robotics, artificial intelligence, and digital businesses. Many believe that such a technological confluence would lead to the realization of the Industry 4.0 (In4.0) vision. The vision had envisaged a close coupling between the different subsystems that make up our industrial system. The industrial subsystems that are expected to involve includes the physical subsystem of industrial machines and robots, the digital subsystem of e-commerce, the cyber subsystem of communication and control networks, and the biological subsystem of the human and animal species (Lasi et al., 2014; Lee

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The most likely consequence of this revolutionary confluence and tight coupling would be an increase in the complexity of the future industrial system.

Inevitably, a complex industrial system envisaged by In4.0 brings many opportunities, but it also presents many challenges. As well as offering the opportunity to improve operational efficiencies through the integration of advanced technologies, Industry 4.0 complexities are likely to challenge our technological specialists and industrial experts from different disciplines to collaborate more effectively, especially in synthesizing and integrating their specialized knowledge and skills. Interdisciplinary work is necessary for creating innovative industrial products and services, but also for mitigating several risks, such as the risk of mass unemployment of skilled workers arising from an industry-wide adoption of robotic automation systems, and the risk of exposing our industrial communication and control networks to the threats from cyber-criminals and cyber-terrorists. Since 4IR and In4.0 both rely heavily on interdisciplinary work practices, this chapter is positioned within an interdisciplinary perspective.

More specifically, in the context of higher education for Industry 4.0, the authors’ position is that preparing graduates for the 4IR requires the design and implementation of interdisciplinary teaching and learning that is aligned to the In4.0 vision. This position is supported by various studies that have established that employees nowadays are increasingly expected by their employers to be more interdisciplinary in enabling their companies to evolve successfully into In4.0 operations (Dujin et al., 2014). Xing and Marwala (2017) contend that In4.0 demands more interdisciplinary teaching. Hence, this chapter sets out to address the issue of re-designing higher education initiatives for Industry 4.0 by focusing on interdisciplinary teaching and learning as a means to redesign learning for Industry 4.0.

Within this focus, the objective of this chapter is to suggest how interdisciplinary learning should be conceptualized so that the design and implementation of interdisciplinary teaching and learning in higher education can be aligned to the In4.0 vision. This chapter fulfils this objective by presenting a multi-case study of interdisciplinary projects in industrial settings. Findings from the study informs the conceptualization of interdisciplinary learning that occurs in interdisciplinary workplaces.

**Background**

Much has been written over the past few decades about the need for graduates who have the ability to engage in interdisciplinary teamwork as well as about the demand for employees who have interdisciplinary expertise for enabling their companies to produce innovative products and services. However, a proper understanding of the term ‘interdisciplinary’ is essential for understanding the underlying requirements.

The Organization of Economic Cooperation and Development (OECD) OECD had define the term ‘interdisciplinary’ in 1972. It refers to the term as “an adjective that describes the interaction between multiple disciplines” (Apostel et al., 1972:p.25-6). However, over the years, the term has been used interchangeably with other terms, most notably, the term ‘multidisciplinary’. It is important to clarify the distinction between the two terms so that the requirements of interdisciplinary work could be ascertained and distinguished from other possible forms of interaction between different disciplines. Scholars of interdisciplinary studies have succinctly clarified the distinctions between the adjectives ‘interdisciplinary’ and ‘multidisciplinary’ by providing the definitions of their corresponding nouns, ‘interdisciplinarity’ and ‘multidisciplinarity’.

For the noun ‘interdisciplinarity’, different definitions have converged towards the process-centric definition (Borrego & Newswander, 2010; Lattuca & Knight, 2010), which was proposed as follows: