Chapter 7
An Evaluation of Group Work in First-Year Engineering Design Education

Stuart Palmer
Deakin University, Australia

Wayne Hall
Griffith University, Australia

ABSTRACT

It is argued that 'design' is an essential characteristic of engineering practice, and hence, an essential theme of engineering education. It is suggested that first-year design courses enhance commencing student motivation and retention, and introduce engineering application content and basic design experience early in the curriculum. The research literature indicates that engineering design practice is a deeply social process, with collaboration and group interactions required at almost every stage. This chapter documents the evaluation of the initial and subsequent second offerings of a first-year engineering design unit at Griffith University in Australia. The unit 1006ENG Design and Professional Skills aims to provide an introduction to engineering design and professional practice through a project-based approach to problem solving. The unit learning design incorporates student group work, and uses self-and-peer-assessment to incorporate aspects of the design process into the unit assessment and to provide a mechanism for individualization of student marks.

INTRODUCTION

It is often argued that 'design' is an (perhaps the) essential characteristic of engineering practice, and hence, an essential theme of engineering education (Atman, Kilgore, & McKenna, 2008; Dym, Agogino, Eris, Frey, & Leifer, 2005; Schubert, Jacobitz, & Kim, 2012). Some authors claim a level of consensus regarding the elements of engineering design (Hubka & Eder, 1987), and a range of normative framings of engineering design can be found (Dym et al., 2005; Howard, Culley, & Dekoninck, 2008; Salter & Gann, 2003; Schubert et al., 2012). Comparative definitions also exist that position engineering design

DOI: 10.4018/978-1-5225-0726-0.ch007

Copyright © 2017, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

in relation to other types of design, i.e., architectural design and computer programming (Lloyd & Scott, 1994). It is often claimed that, "Design requires unique knowledge, skills, and attitudes common to all engineering disciplines, and it is these attributes that distinguish engineering as a profession." (Atman et al., 2008, p. 309) Hence it is not surprising to see engineering design identified as a key element of engineering education:

Engineering design is a critical element of engineering education and a competency that students need to acquire. (Atman et al., 2007, p. 359)

… the purpose of engineering education is to graduate engineers who can design, and that design thinking is complex. (Dym et al., 2005, p. 103)

Typically, exposure to aspects of design are distributed throughout the undergraduate engineering curriculum (Davis, Gentili, Trevisan, & Calkins, 2002). Student design projects have long been used as a key pedagogical element for the development of engineering student design skills and knowledge. Traditionally, these have taken two complementary forms:

- **Final-Year Design Courses:** Open referred to as 'capstone' design courses (Dutson, Todd, Magleby, & Sorensen, 1997); and
- **First-Year Design Courses:** Often referred to as 'cornerstone' design courses.

Cornerstone design courses arose as a response to perceptions that first-year engineering curricular, historically loaded with math, physics and other theoretical foundation studies, often left commencing students wondering what engineers actually do. It is suggested that first-year design courses enhance commencing student motivation and retention, and introduce engineering application content and basic design experience early in the curriculum (Dym et al., 2005).

Computer-Aided Design (CAD) has been a part of engineering design since the 1960s, and by the 1990s developments in low-cost computer hardware and electronic communications made CAD a ubiquitous element of engineering design (Salter & Gann, 2003). CAD was traditionally associated with the production of design drawings and other documentation, but CAD can be used in all phases of the engineering design process (Hubka & Eder, 1987). Even if only for the documentation of engineering design concepts, CAD plays an important role as an enabler of group design work via the formal representation of design information in a standard and unambiguous form that minimizes errors in the sharing of design concepts between members of the design team (Brereton & McGarry, 2000). In engineering education, evidence of the close association between engineering design and CAD can be observed in the commonly found pairing of training in the use of CAD systems combined with introductory engineering design theory and practice in a single unit of study.

There is evidence that experienced engineers carry out design activities in qualitatively different ways to novice or less experienced engineers. And, if engineering students are considered as 'student engineers', a similar growth in sophistication in engineering design output has been observed between junior and senior students. As part of a longitudinal investigation into undergraduate engineering student design performance, data were collected on how both freshmen (commencing) and senior students conducted design exercises (Atman, Cardella, Turns, & Adams, 2005; Atman, Chimka, Bursic, & Nachtmann, 1999). It was observed that senior student performance was better than freshman performance with re-

22 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/an-evaluation-of-group-work-in-first-year-engineering-design-education/165680

Related Content

Bridging Synthetic and Organic Materiality: Gradient Transitions in Material Connections
Hironori Yoshida (2012). *Biologically-Inspired Computing for the Arts: Scientific Data through Graphics (pp. 81-88).*
www.irma-international.org/chapter/bridging-synthetic-organic-materiality/65023

Energy and Environment
(2014). *Computational Solutions for Knowledge, Art, and Entertainment: Information Exchange Beyond Text (pp. 200-217).*
www.irma-international.org/chapter/energy-and-environment/85391

From Zero to Infinity: A Story of Everything
Clayton S. Spadaand Victor Raphael (2012). *Biologically-Inspired Computing for the Arts: Scientific Data through Graphics (pp. 356-377).*
www.irma-international.org/chapter/zero-infinity-story-everything/65038

Calligraphic Video: Using the Body's Intuition of Matter
Sha Xin Wei (2010). *International Journal of Creative Interfaces and Computer Graphics (pp. 67-83).*
www.irma-international.org/article/calligraphic-video-using-body-intuition/41712

Detecting Bias on Aesthetic Image Datasets
Adrian Carballal, Luz Castro, Rebeca Perezand João Correia (2014). *International Journal of Creative Interfaces and Computer Graphics (pp. 62-74).*
www.irma-international.org/article/detecting-bias-on-aesthetic-image-datasets/120642