Chapter 5
Module-Based Teaching of Mechanical Design

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ABSTRACT

Teaching engineering in the context of practical problems has been suggested as a way to motivate and interest students. By module-based teaching, it is possible to make the contents easier for the students to imbibe and to highlight the interdisciplinary nature of mechanical design. The purposes of this chapter are to describe (1) five modules for introducing Mechanical Design courses in Mechanical Engineering, (2) the differences in emphases of the modules, (3) the most important aspects of the modules, (4) student reactions to the module-based teaching approach, and (5) student reactions in terms of the ease of learning. It was found that module-based teaching of mechanical design improves learning ability and students' satisfaction significantly.

INTRODUCTION

It is possible to enhance teaching and learning by incorporating different approaches of teaching and different educational tools, including technological tools (Pramanik et al., 2014). Technological tools, such as information and communication technologies, online games, online learning, iPods and others, affect the teaching/learning process through learning management systems, personal response systems, discussion boards, blogs, wikis, social networking, podcasts and a variety of web-based mechanisms. On the other hand, different approaches in teaching—such as critical incident analysis, identifying attributes of workplace problems, module-based teaching, emphasis on strategic engineering education and the like—ease the process of student learning. All these educational tools have been tested for different teaching units in different subject areas and

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have improved students' learning (Pramanik et al., 2013). This chapter investigates the module-based teaching method to teach Mechanical Design at the undergraduate level.

This Mechanical Design unit is taught in the second year of the Mechanical Engineering course. The objective is to introduce this basic and core unit to the fresh minds, which helps students get into the subject matter very easily. In addition, the knowledge can be used in the third and fourth years in other units as well as projects. Knowledge of the strength of materials is highly essential to understanding many aspects of mechanical design. Therefore, some content from the Strength of Materials course is included in this Mechanical Design unit to refresh students' knowledge in this area. The students enrolled in this unit are of diverse multicultural and educational backgrounds, and year to year the enrolment numbers have varied from 225 to 325. It is hard to manage and attract the attention of students in this class because of the cultural diversity and the mixture of student learning capabilities.

With the advancement of technology, the increase of learning materials and the interdisciplinary nature of courses, it is time to rethink the way engineering is taught. Many of the courses in engineering are frustrating because the material is difficult and boring due to the lack of proper teaching methods. Students choose to drop out of these courses or fail in exams. Mechanical Design is one of several courses which are very essential for students of Mechanical Engineering. A Mechanical Engineering degree cannot be completed without a proper understanding of mechanical design. It is believed that the dropout rates for these courses or the high failure rate on exams is because of the insufficient talent and attention of students. However, the brighter students often leave because of disinterest (Carter et al., 1989; Seymour, 1995; Tobias, 1992). This can be avoided through a cooperative learning approach which supports students in terms of intrinsic motivation, higher-level reasoning, academic and social support, social development, and self-esteem, etc. The best learning is achieved when (i) students build on and relate to past experiences, (ii) the content is relevant to them, (iii) there is a chance for a direct "hands-on" experience and (iv) students can construct their own knowledge in collaboration with other students and faculty to communicate effectively (Anthony et al., 1998). Thus module- or structure-based teaching brings almost all these aspects together, where the modules are based on questions from students that relate the subject matter to practical applications. This chapter describes a module-based approach to teaching mechanical design to increase students' interest in engineering and to raise their awareness of the connection between engineering and practical issues.

Module-based teaching consists of several components of varying length within a course unit. Each module is based on an interesting question that provides a background for understanding and applying specific mechanical design knowledge. The module question and background deliver an appropriate framework for exploration of the subject matter. Each component of the course unit emphasises a smaller and more specific question through explorations. The explorations can be based on practical experience, in-class and out-of-class exercises, and laboratory activities. The final component of the course unit is project based, intended for assessment of student learning of mechanical design and scientific thinking skills. Teaching engineering in the context of practical problems has been suggested as a way to motivate and interest students. By module-based teaching, it is possible to make the contents easier for the students to imbibe and to highlight the interdisciplinary nature of mechanical design.

The purposes of this chapter are to: (1) describe nine modules for introducing Mechanical Design curricula in Mechanical Engineering courses; (2) describe the differences in emphases of the modules; (3) determine the most important aspects